PHILIPS MEDICAL SYSTEMS

M8000

Service Manual

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This document prepared by the PMSTL Service Innovation Department.

For any additions, corrections, or suggestions, contact:
PMSTL Customer Support Department

Email: _1HFA_Support_e2@philips.com

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			X-ray System Troubleshooting added	Chap. 4			
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			WCS Parts Replacement added	Chap. 7			
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REVISION HISTORY

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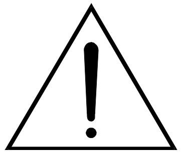
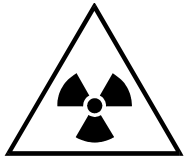
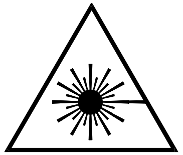
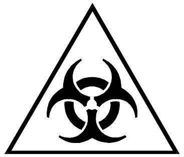
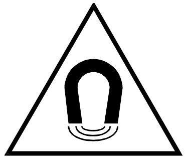
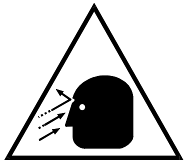
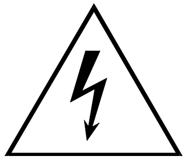
			Chapter Stop Report added	Chap. 11			
			Chapter Service tools added	Chap. 12			
			Chapter CANpro added	Chap. 13			
			Chapter Software Installation added	Chap. 14			
			Chapter Image Quality added	Chap. 15			

SYMBOL DESCRIPTIONS

	Attention symbol.		Radiation warning symbol.
	Laser warning symbol.		Biohazard warning symbol.
	Magnetism warning symbol.		Projectile warning symbol.
	Electrical warning symbol.		

TO THE USER OF THIS MANUAL

THE USER OF THIS MANUAL IS DIRECTED TO READ AND CAREFULLY REVIEW THE INSTRUCTIONS, WARNINGS AND CAUTIONS CONTAINED HEREIN PRIOR TO BEGINNING INSTALLATION OR SERVICE ACTIVITIES. WHILE YOU MAY HAVE PREVIOUSLY INSTALLED OR SERVICED EQUIPMENT SIMILAR TO THAT DESCRIBED IN THIS MANUAL, CHANGES IN DESIGN, MANUFACTURE OR PROCEDURE MAY HAVE OCCURRED WHICH SIGNIFICANTLY AFFECT THE PRESENT INSTALLATION OR SERVICE.

THE INSTALLATION AND SERVICE OF EQUIPMENT DESCRIBED HEREIN IS TO BE PREFORMED BY AUTHORIZED, QUALIFIED PHILIPS MEDICAL SYSTEM (CLEVELAND), INC. PERSONNEL. ASSEMBLERS AND OTHER PERSONNEL NOT EMPLOYED BY NOR DIRECTLY AFFILIATED WITH PHILIPS MEDICAL SYSTEMS (CLEVELAND), INC. TECHNICAL SERVICES ARE DIRECTED TO CONTACT THE LOCAL PHILIPS MEDICAL SYSTEMS (CLEVELAND), INC. OFFICE BEFORE ATTEMPTING INSTALLATION OR SERVICE PROCEDURES.

INSTALLATION AND ENVIRONMENT

EXCEPT FOR INSTALLATIONS REQUIRING CERTIFICATION BY THE MANUFACTURER PER FEDERAL STANDARDS, SEE THAT A RADIATION PROTECTION SURVEY IS MADE BY A QUALIFIED EXPERT IN ACCORDANCE WITH NCRP 102, SECTION 7, AS REVISED OR REPLACED IN THE FUTURE. PERFORM A SURVEY AFTER EVERY CHANGE IN EQUIPMENT, WORKLOAD, OR OPERATING CONDITIONS WHICH MIGHT SIGNIFICANTLY INCREASE THE PROBABILITY OF PERSONS RECEIVING MORE THAN THE MAXIMUM PERMISSIBLE DOSE EQUIVALENT.

Diagnostic Imaging Systems - MECHANICAL-ELECTRICAL WARNING

ALL OF THE MOVEABLE ASSEMBLIES AND PARTS OF THIS EQUIPMENT SHOULD BE OPERATED WITH CARE AND ROUTINELY INSPECTED IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS CONTAINED IN THE EQUIPMENT MANUALS.

ONLY PROPERLY TRAINED AND QUALIFIED PERSONNEL SHOULD BE PERMITTED ACCESS TO ANY INTERNAL PARTS. LIVE ELECTRICAL TERMINALS ARE DEADLY; BE SURE LINE DISCONNECTS ARE OPENED AND OTHER APPROPRIATE PRECAUTIONS ARE TAKEN BEFORE OPENING ACCESS DOORS, REMOVING ENCLOSURE PANELS, OR ATTACHING ACCESSORIES.

DO NOT UNDER ANY CIRCUMSTANCES, REMOVE THE FLEXIBLE HIGH TENSION CABLES FROM THE X-RAY TUBE HOUSING OR HIGH TENSION GENERATOR AND/OR THE ACCESS COVERS FROM THE GENERATOR UNTIL THE MAIN AND AUXILIARY POWER SUPPLIES HAVE BEEN DISCONNECTED. FAILURE TO COMPLY WITH THE ABOVE MAY RESULT IN SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

ELECTRICAL-GROUNDING INSTRUCTIONS

THE EQUIPMENT MUST BE GROUNDED TO AN EARTH GROUND BY A SEPARATE CONDUCTOR. THE NEUTRAL SIDE OF THE LINE IS NOT TO BE CONSIDERED THE EARTH GROUND. ON EQUIPMENT PROVIDED WITH A LINE CORD, THE EQUIPMENT MUST BE CONNECTED TO PROPERLY GROUNDED, THREE-PIN RECEPTACLE. DO NOT USE A THREE-TO-TWO PIN ADAPTER.

Diagnostic Imaging Systems - RADIATION WARNING

X-RAY AND GAMMA-RAYS ARE DANGEROUS TO BOTH OPERATOR AND OTHERS IN THE VICINITY UNLESS ESTABLISHED SAFE EXPOSURE PROCEDURES ARE STRICTLY OBSERVED.

THE USEFUL AND SCATTERED BEAMS CAN PRODUCE SERIOUS OR FATAL BODILY INJURIES TO ANY PERSONS IN THE SURROUNDING AREA IF USED BY AN UNSKILLED OPERATOR. ADEQUATE PRECAUTIONS MUST ALWAYS BE TAKEN TO AVOID EXPOSURE TO THE USEFUL BEAM, AS WELL AS TO LEAKAGE RADIATION FROM WITHIN THE SOURCE HOUSING OR TO SCATTERED RADIATION RESULTING FROM THE PASSAGE OF RADIATION THROUGH MATTER.

THOSE AUTHORIZED TO OPERATE, PARTICIPATE IN OR SUPERVISE THE OPERATION OF THE EQUIPMENT MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH THE CURRENT ESTABLISHED SAFE EXPOSURE FACTORS AND PROCEDURES DESCRIBED IN PUBLICATIONS, SUCH AS: SUBCHAPTER J OF TITLE 21 OF THE CODE OF FEDERAL REGULATIONS, "DIAGNOSTIC X-RAY SYSTEMS AND THEIR MAJOR COMPONENTS", AND THE NATIONAL COUNCIL ON RADIATION PROTECTION (NCRP) NO. 102, "MEDICAL X-RAY AND GAMMA-RAY PROTECTION FOR ENERGIES UP TO 10 MEV-EQUIPMENT DESIGN AND USE", AS REVISED OR REPLACED IN THE FUTURE.

THOSE RESPONSIBLE FOR PLANNING OF X-RAY AND GAMMA-RAY EQUIPMENT INSTALLATIONS MUST BE THOROUGHLY FAMILIAR AND COMPLY COMPLETELY WITH NCRP NO. 49, "STRUCTURAL SHIELDING DESIGN AND EVALUATION FOR MEDICAL OF X-RAYS AND GAMMA-RAYS OF ENERGIES UP TO 10 MEV", AS REVISED AND REPLACED IN THE FUTURE. FAILURE TO OBSERVE THESE WARNINGS MAY CAUSE SERIOUS OR FATAL BODILY INJURIES TO THE OPERATOR OR THOSE IN THE AREA.

SAFETY INFORMATION

ONLY QUALIFIED AND SYSTEM TRAINED PHILIPS SERVICE STAFF IS ALLOWED TO PERFORM SERVICE (INSTALLATION, MAINTENANCE, QUALITY ASSURANCE) ON THE MX8000 AND MX8000 DUAL SYSTEMS. MAKE SURE THAT THE LATEST VERSION OF THE SERVICE INSTRUCTIONS ARE AVAILABLE. READ THE CORRESPONDING INSTRUCTIONS CAREFULLY PRIOR TO WORKING ON THE SYSTEM. FOR YOUR OWN SAFETY AND FOR MORE DETAILED SAFETY INFORMATION, REFER ONLY TO THE CURRENT VERSION OF THE DOCUMENTS.

USE ONLY SPECIFIED TOOLS AND AUXILIARY MATERIALS.

Precautionary Measures Regarding Electrical Voltage

BEFORE YOU START THE PROCEDURE OUTLINED IN THIS MANUAL, MAKE SURE THAT YOU READ AND UNDERSTAND THE WARNINGS LISTED BELOW.

⚠ WARNING ⚡

ELECTRICAL HAZARD! PRIOR TO ANY SERVICE AND MAINTENANCE ACTIVITIES INSIDE COMPONENTS:

- **SWITCH OFF THE SYSTEM AT THE MAIN POWER SUPPLY, (USING THE ON-SITE ON-OFF SWITCH) AND THE INTERNAL/EXTERNAL UNINTERRUPTIBLE POWER SUPPLY (UPS)**
- **MAKE SURE THAT NO OTHER PERSON CAN SWITCH ON POWER OR SWITCH OFF THE SECURITY MEASURES, WHEN INSTALLATION, MAINTENANCE OR SERVICE WORK ON THE SYSTEM IS PERFORMED.**

⚠ WARNING ⚡

ELECTRICAL HAZARD! WHEN PERFORMING ANY PROCEDURE INSIDE THE PDC:

- **SWITCH OFF ALL EXTERNAL POWER, E.G. POWER FOR X-RAY WARNING LAMP.**
- **PRIOR TO ANY INTERVENTION IN THE PDC, ALLOW AT LEAST FIVE MINUTES DISCHARGE TIME AFTER THE LAST SCAN. HAZARDOUS VOLTAGE LEVELS (>500V) MAY BE PRESENT EVEN IF THE SYSTEM IS SWITCHED OFF.**

AFTER FINISHING ANY SERVICE ACTIVITY, ENSURE THAT ALL COVERS OF THE MX8000 AND MX8000 DUAL, INCLUDING THE MYLAR GASKET, ARE CLOSED.

SAFETY:

IN ADDITION TO THE WARNINGS LISTED ABOVE, MAKE SURE TO FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN CHAPTER 1 OF THE MX8000 SERVICE MANUAL. FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

⚠ CAUTION

ALWAYS USE AN ESD PROTECTION WRIST STRAP WHEN SERVICING ANY COMPONENT IN THE SYSTEM.

How this Manual is Organized

This manual provides the information necessary to service and maintain the Mx8000 CT scanner. The manual is organized in chapters according to the major system components.

Each chapter contains the following:

- An engineering description of the subassemblies of each main component
- Diagnostic and analytical tools and techniques for locating and troubleshooting problems
- Detailed procedures for the replacement of all subassemblies (FRUs)

This manual is presented in landscape format for easy viewing on the Field Service Engineer’s computer. In addition to the bookmarks displayed in Acrobat Reader, the user can take advantage of the Tables of Contents at the start of each chapter. These navigation tools enable the FSE to find the necessary information quickly.

The manual is organized in the following chapters:

CHAPTER	TOPICS	CHAPTER	TOPICS
Preface	Terms and Abbreviations, FSE Tool Kit	*Chapter 8*	Network Installation and Configuration
Chapter 1	**MANDATORY READING!** • Safety Instructions • ESD Protection Procedure	*Chapter 9*	System Cables
		Chapter 10	System Options
Chapter 2	Operating Station	*Chapter 11*	Stop Report
Chapter 3	Gantry	*Chapter 12*	Service Tools
Chapter 4	X-ray System	*Chapter 13*	CANpro
Chapter 5	Patient Table	*Chapter 14*	Software Installation
Chapter 6	PDC (Power Distribution Cabinet)	*Chapter 15*	Image Quality
Chapter 7	WCS (Water Cooling System)	*Appendix A*	Electrical Line Inspection

Table of Contents

How this Manual is Organized . . . .

Preface 1

Definitions and Abbreviations 1

CT Terms 1

CT Sub-assemblies 2

General Terms 3

Standard FSE Tool Kit 3

Chapter 1
General

Safety Guidelines 1-1

Overview 1-1
General Precautions 1-2
    General Service Safety Procedures and Information 1-2
    Explanation of Symbols 1-3
    Electrical Installations 1-3
    Installation of Electro-medical Systems and Equipment 1-3
    Personal Protection Measures (Occupational Safety) 1-4
Service Precautions 1-8
    Precautions Against Mechanical Hazards 1-9
    Precautions Against Electrical Hazards 1-11
    Precautions Against Radiation Hazards 1-12
System Specific Safety Precautions 1-13
    Working with System Components 1-13
Attaching Screws and Nuts 1-18
    Tightening Torques for Screw Connections 1-20
    Using LOCTITE 1-21
ESD (Electrostatic Discharge) 1-23
    ESD—Anti-Static Field Service Kit 1-24
    Purpose 1-24
    Tools 1-24
    Parts 1-24
    Procedure 1-26
    Connecting the ESD Field Service Kit 1-29

Chapter 2
Operating Station

Overview 2-1

About the Operating Station 2-1
  Operator Console 2-1
  Computer Rack 2-1

Operator Console 2-2

Monitor 2-4
Keyboard 2-4
Mouse 2-4
CT Box (Scan Control Unit) 2-5
  Gantry Control Panel 2-8
  Intercom Panel Board 2-9
  Scan Operation Board 2-16
  Encoder Board (NOT ACTIVE) 2-17

Computer Rack 2-21

  Installing the Mx8000 Workstation 2-30
System First-Time Operation 2-31
  Turning On The Workstation 2-31
  Logging In and Out of the Workstation 2-33
  The Toolchest 2-34
  Checking The System Hardware Inventory 2-35
  Setting System Time and Date 2-36
  Turning The Workstation Off 2-37
Replacing Internal Mx8000 Modules 2-39
  Replacing the System Module 2-39
  Installing Memory Options (MEM-4, MEM-5, MEM-6 and MEM-7) 2-39
  Checking The New Memory 2-40
  Replacing the Internal Hard Disk 2-41
  Replacing the Power Supply 2-41
  Replacing the CD-ROM Drive 2-41
Installing External Mx8000 Peripherals 2-42
  Installing the EOD Drive 2-42
Architecture 2-48
  24 SHARC Configuration - for Mx8000 Basic and Mx8000 Dual (Optional) Systems 2-50
  16 SHARC Configuration - for Mx8000 Dual Systems 2-51
  Parallel Backprojector Board 2-66

Diagnostics and Troubleshooting 2-78

IRS Troubleshooting 2-78
  Preface 2-78
  Safety Instructions 2-79
  Scenarios of IRS Problems 2-80
  IRS Configuration 2-82
  Scenario #1 2-83
  Scenario #2 2-89

IRS Diagnostic Supplement 2-97
Commands and Supplementary Data 2-120
Diagnostic Tools and Commands 2-126
DMC Diagnostic (using Mercury Commands) 2-160
DMC Diagnostic 2-160
DMC Test Procedure 2-161
DMC Sample Test Results 2-162
Example of a DMC Test Failure 2-168
System and Expansion Card Jumper Settings 2-169
System Card D1 (Old Revision 900-07010) 2-170
Expansion Card D2 (Old Revision 900-07022) 2-172
System Card D1 (New Revision) 2-173
Expansion Card D2 (New Revision) 2-175
PCI Link Card 2-177

Chapter 3
Gantry

System Control 3-1

System/MCB 3-1
System/CAN 3-4
CAN 3-5
System/Hardwired Signals 3-6

Slip Ring Assembly 3-7

Overview 3-7
Functional Description 3-9
  Serial Data Signals 3-9
  Error Signals 3-10
  CAN and Stop-Report Signals 3-12

Gantry Stationary Overview 3-14

Components 3-14

Gantry Stationary Functional Description 3-16

Gantry Stationary Functions 3-16
  Rotation Overview 3-18
  Rotation Functions 3-20
  Gantry Tilt Overview 3-27
  Gantry Tilt Functions 3-30
  Gantry Cooling 3-37
  Patient Handling Control (PHC) 3-37
  Audio-Intercom 3-40
  X-Ray Control 3-42
  Patient Table Interface 3-44
  System Interface 3-46
  Power Supply Stationary 3-48
  Phases Description 3-50

Gantry Stationary Diagnostics and Troubleshooting 3-56

Testing the MCU_MCB Board 3-57
Testing the RTC_MCB Board 3-58
  Frequency Converter (FC) Interface Rotation Test 3-58
  Maximum Speed Limit Test 3-59
  Angle Pulse (AP) Test 3-60
  Frequency Converter (FC) Tilt Test 3-60
  Tilt Test 3-60
Testing the GPC Board 3-60
Verifying Correct Water Hose Connections in the Gantry 3-62
  Procedure 3-62
  Water Hose Replacement in Case of Incorrect Positioning 3-65
  Final Step 3-66

Gantry Stationary Parts Replacement 3-67

Overview 3-67

Left Side of the Gantry 3-68
Right Side of the Gantry 3-69
Replacing the Rotation Frequency Converter (E301) 3-72
Replacing the Tilt Sensor 3-75
Adjusting the Tilt Sensor 3-77
Replacing the Tilt Frequency Converter (E302) 3-79
Replacing the MCU RTC Board (D301) 3-81
Replacing the Tilt Spindle 3-83
Required Tools and Auxiliary Materials 3-83
Preliminary Steps 3-83
Removing the Tilt Spindle 3-85
Installing the Tilt Spindle 3-86
Cable Connections 3-87
Test and Adjustments 3-89
Final Steps 3-89
Replacing the Three-Way Valve 3-90
Replacing the GPC Board (D311) 3-92
Replacing the Dehumidifier 3-94
Replacing the Noise Cancellation Board (D344) 3-96
Replacing the Brake Assembly (E322) 3-98
Replacing the Transmitter and Receiver Boards 3-100
Replacing the Gantry Heat Exchanger 3-102
Replacing the Fan 3-104
Removal and Installation of the Funnel 3-107
Replacement and Adjustment of the Stator Laser Light Markers 3-109
Removal of the Laser Light Marker 3-109
Installing the New Laser Light Marker 3-110
Tests and Adjustments 3-110
Final Steps 3-111

Gantry Rotating Overview 3-112

Components 3-112
Gantry Rotating Functions 3-115

Gantry Rotating Functional Description 3-116

Focus Deflection 1 3-116
Overview 3-116
LEDs 3-119
Test Points 3-121
Signals 3-123
Focus Deflection 2 3-125
Overview 3-125
Signals 3-125
Z-Control 3-127
Overview 3-127
LEDs 3-127
Test points 3-129
Signals 3-131
A-Plane Collimation 3-132
Overview 3-132
LEDs 3-132

Test Points 3-135
Signals 3-137
P-Plane Collimation 3-138
Overview 3-138
Switches 3-139
LEDs 3-139
Test Point 3-141
Signals 3-141
Light Marker 3-142
Overview 3-142
Signals 3-142
Air Scan Compensator 3-144
Overview 3-144
LEDs 3-144
Signals 3-145
Ultra High Resolution (UHR) Collimator 3-147
Overview 3-147
Switches 3-147
LEDs 3-148
Signals 3-150
Tube Monitoring 3-151
Overview 3-151
Signals 3-151
Acquisition Control 1 3-154
Overview 3-154
Switches 3-155
LEDs 3-156
Signals 3-158
Acquisition Control 2 3-161
Signals 3-161
Communication Channels 3-163
Power Supply 3-165
DPU1 and DPU2 3-165
Power Supply ZCON 3-168
Power Supply DELPHI and DOM 3-170
Power Supply Tube Collimator Box 3-172

Gantry Rotating Diagnostics and Troubleshooting 3-174

Slip Ring Troubleshooting 3-174
Inhomogeneity and Damages to the Polyurethane (PU) 3-174
Rework Instruction for Pollution on Tracks 3-179
Further Possible Defects 3-180

Gantry Rotating Parts Replacement 3-182

Overview 3-182
Replacing the Tube Collimator (E555) 3-183
Preparations 3-183
The Tube Collimator Removal 3-184
Tube Collimator Installation 3-185
Final Steps 3-186
Replacing the PHI_Amp (D555) Board 3-187

Preparations 3-187
PHI_Amp Board Removal 3-188
PHI_Amp Board Installation 3-188
Final Steps 3-189
Replacing the PHI_Z_MON (D554) Board 3-190
Preparations 3-190
PHI_Z_Mon Board Removal 3-191
PHI_Z_Mon Board Installation 3-192
Final Steps 3-192
Replacing Converter (C) Box Components 3-193
Replacing the Back Plane of the C-Box (E510) 3-194
Replacing the DPU_1 Board (E540) 3-199
Removing the Old DPU_1 Board 3-200
Installing the New DPU_1 Board 3-200
Final Steps 3-200
Replacing the DPU_2 Board (E541) 3-201
Replacing the DELPHI Board (D515) 3-203
Replacing the Z_CON Board (D514) 3-205
Replacing the ACU Board (D513) 3-207
Replacing the Rotating Light Markers (E581-4) 3-209
Preparations 3-210
Removing the Old Light Marker 3-211
Installing the New Light Marker 3-212
Final Steps 3-212

DMS (Data Measurement System) 3-213

DMS Overview 3-213
Detectors 3-218
Gated Integrator (GI) Cards 3-221
RCOM Card 3-237
DMS Temperature Control Cards 3-254
Lower Beam 3-256
Overview 3-256
P-Plane Collimator (Detector Diaphragm) 3-256
Ultra High Resolution (UHR) Collimator 3-260

DMS Parts Replacement 3-263

ESD—Anti-Static Field Service Kit 3-264
Purpose 3-264
Tools 3-264
Parts 3-264
Procedure 3-266
Replacing Data Measurement System Components 3-272
Replacing the Complete DMS 3-273
Introduction 3-273
Parts List 3-274
Unpacking the DMS Field Replacement Unit 3-276
Disconnecting the Old DMS 3-277
Removing the Old DMS 3-281
Removing extra weights from the rotor 3-288

  - Installing the New DMS 3-290
  - Connecting the New DMS Unit 3-293
  - Balancing the Rotor 3-294
  - Entering New DMS Encoder Settings 3-294
  - Mx8000 Physics Calibration 3-296
  - Mx8000 Acceptance Test 3-296
  - Image Noise Standard Deviation Checks 3-296
  - Mx8000 Dual Physics Calibration 3-296
  - Mx8000 Dual Acceptance Test 3-297
  - Image Noise Standard Deviation Checks 3-297
- Removing the Cover of the DMS 3-298
- Replacing the Cradle Assembly 3-299
- Replacing the P-Plane Motor 3-304
  - Disassembly of the Old Motor 3-304
  - Assembly of the New Motor 3-306
  - Testing the Detector Collimator Movement—Examination of the Proper Functioning of the New Motor 3-307
- Replacing the Encoder of the P-Plane 3-308
  - Installing the New Encoder 3-308
  - Calibrating P-Plane Stops 3-310
  - Finding and Recording Hexadecimal Encoder Readings 3-311
- P-Plane Collimator Host Table Set-up 3-315
  - Validity 3-315
  - Procedure 3-316
- Replacing the Optical Switch of the P-Plane 3-318
- Replacing the P-Plane Mylar 3-321
- Replacing the Cradle Temperature Sensor 3-322
- Replacing GI Cards 3-324
- Replacing Detector Modules 3-326
- Replacing the Cover Temperature Sensors 3-328
  - Replacing the Left Temperature Sensor 3-328
  - Replacing the Right Temperature Sensor 3-329
- Replacing the DMS OFF Control Card 3-330
- Replacing the Fan Power Distribution Board 3-331
- Replacing the DMS Cover Fan 3-332

Chapter 4
X-ray System

Overview 4-1

Components 4-1
Functions 4-1
Block Diagram 4-2

Functional Description 4-3

The Main Assemblies 4-3
Gantry Generator Power Supply (E606) 4-4
The Electronic Box (E603) 4-7
    Power Supply and Filtering 4-7
    The Main Inverters 4-7
    Resonance Circuit 4-10
    Inverter Output 4-10
    Ignition Circuit 4-10
    Inverter Monitoring (Inverters 1 and 2) 4-11
    Inverter Monitoring (Inverter 1 only) 4-11
    Signals in the Electronic Box 4-11
Main Control Board (D400) 4-14
    Triggering the Inverters 4-15
    Enabling and Starting the Inverters 4-15
    Main Control Board Signals 4-16
    Inverter Monitoring 4-18
    Inverter Monitoring Signals 4-20
    High Voltage Monitoring 4-23
High Voltage Tank (E604) 4-27
    Overview 4-27
    High Voltage Output Signals 4-27
Filament Power Board (D470) 4-30
    Functionality 4-30
    Filament Power Board Signals 4-31
Rotating Anode Control Board (D115) 4-35
    Anode Drive 4-35
    Rotating Anode Control (RAC) Board Signals 4-35

Diagnostics and Troubleshooting 4-38

Introduction 4-38
Safety 4-38
X-ray System FRUs 4-39
X-ray System Block Diagram 4-39
Can Control System 4-40
    Troubleshooting Flow Chart 4-41
    Flowchart 1 4-42
    Flowchart 2 4-43
    General Diagnostic Tools and Procedures 4-47
Frequency Adaptation Calibration 4-48
    Introduction 4-48
    Procedure 4-49

Dummy Plugs Test 4-52
XRS Anode Starter Resistance Measurement 4-55
X-ray Tube Filaments Resistance Measurements 4-58
Single Pulse Test 4-60

Parts Replacement 4-66

Replacing the X-Ray Tube 4-66
Tube Cooling Membrane Inspection 4-66
X-ray Tube Replacement 4-67
Final Steps 4-81
Replacing the E603 Electronic Box (E-Box) 4-82
Tools and Auxiliary Materials Required 4-83
Preparations 4-83
Removing the Old E-Box 4-85
Installing the New E-Box 4-92
Final Steps 4-94
Tests and Adjustments 4-94
Replacing the High Voltage (HV) Tank (E604) 4-95
Tools and Auxiliary Materials Required 4-95
Preparations 4-96
Removing the Old Tank 4-98
Installing the New Tank 4-101
Final Steps 4-101
Tests and Adjustments 4-102
Replacing the Main Control Board (D400) 4-103
Tools and Auxiliary Materials Required 4-103
Preparations 4-104
Removing the Old Main Control Board 4-105
Installing the New Main Control Board 4-107
Final Steps 4-107
Tests and Adjustments 4-107
Replacing the Fil (D470)/RAC (D115) Assembly 4-108
Tools and Auxiliary Materials Required 4-108
Estimated Time 4-109
Preparations 4-109
Removing the Old FIL/RAC Assembly 4-110
Fil/RAC Installation 4-115
Final Steps 4-115
Replacing the X-Ray Tube Heat Exchanger 4-116
Overview 4-116
Procedure 4-117
Removing the Aluminum Frame 4-122
Installation of the New Assembly 4-124
System Check After Installation 4-126
Replacing the Electronic Box Fan 4-127
Tools and Auxiliary Materials Required 4-127
Preparations 4-127
Removing the Old Fan 4-128
Installing the New Fan 4-129
Final Steps 4-129
Tests and Adjustments 4-129

Replacing Fuses F4 and F5 in the Electronic Box 4-130
  Tools and Auxiliary Materials Required 4-130
  Preparations 4-130
  Changing the Fuses 4-131
  Final Steps 4-132
  Tests and Adjustments 4-133

Chapter 5
Patient Table

Functional Description 5-1

The Main Assemblies 5-1
Patient Table Horizontal (PTH) Controller 5-3
Patient Table Vertical (PTV) Controller 5-3
Horizontal Movement 5-3
Tabletop Drive 5-6
Tabletop Drive Signals 5-10
Top Support Drive 5-11
Vertical Movement 5-16
Vertical Movement 1 5-16
Vertical Movement 2 5-22
Vertical Movement Signals 5-24
Power Supply 5-25
Power Supply Signals 5-28

Parts Replacement 5-30

Removing Table Covers 5-30
Procedure 5-31
Bellows/Vertical Electronics (D702) 5-33
Tabletop/Horizontal Electronics (D701) 5-33
Preparation 5-35
Main Procedure 5-36
Installing the Covers 5-39
Table Lift Motor 5-40
Removing the Table Lift Motor 5-42
Installing the Table Lift Motor 5-45
Inverter for the Table Lift Motor 5-48
Removing the Inverter for the Table Lift Motor 5-49
Installing the Inverter for the Table Lift Motor 5-50
Final Steps 5-50
PT Vertical Board 5-51
Removing the PT Vertical Board 5-52
Installing the PT Vertical Board 5-53
Connect Switch S704 5-54
Removing Connect Switch S704 5-55
Installing Connect Switch S704 5-55
Spindle Brake 5-57
Removing the Spindle Brake 5-59
Installing the Spindle Brake 5-59
Vertical Position Potentiometer 5-61
Installing the Vertical Position Potentiometer 5-63
Horizontal Tabletop Motor 5-64
Removing the Horizontal Tabletop Motor 5-66
Installing the Horizontal Tabletop Motor 5-67
Tabletop Encoder 5-68
Removing the Tabletop Encoder 5-70

Installing the Tabletop Encoder 5-70
Horizontal Motor for Tabletop Support 5-71
Removing the Horizontal Motor for the Tabletop Support 5-72
Installing the Horizontal Motor for the Tabletop Support 5-73
PT Horizontal Board 5-74
Removing the PT Horizontal Board 5-75
Installing the PT Horizontal Board 5-76
Tabletop Drive 5-77
Removing the Tabletop Drive 5-78
Installing the Tabletop Drive 5-86
Top Support Drive 5-94
Removing the Top Support Drive 5-95
Installing the Top Support Drive 5-103
Upper Side Table Covers 5-111
Removing Upper Side Table Covers 5-112
Installing 5-117

Adjustment and Calibration 5-120

Patient Table Horizontal (PTH) Adjustment 5-120
Introduction 5-120
Tools Required: 5-120
System Preparation: 5-122
Tabletop Adjustment 5-126
Tabletop Support Adjustment 5-128
Verifying Couch Accuracy 5-129
Patient Table Vertical (PTV) Adjustment 5-130
Introduction 5-130
Required Materials 5-130
Procedure 5-131

Troubleshooting 5-138

Cleaning of the Couch Vertical Motor Brake 5-138
Procedure 5-138
Final Step 5-140

Chapter 6
PDC (Power Distribution Cabinet)

Functional Description 6-1

Power Connections 6-1
Direct Current Circuit (DCC) 6-1
Power Distribution System (PDS) 6-3
    Optional Line Compensation 6-3
    Operating Station (Computer Rack) 6-4
    UPS_1 6-4
    Monitor (Second Monitor) 6-4
    DCC Circuit 6-4
    Gantry 6-4
    UPS2 6-5
    Patient Handling System (PHS) 6-6
    Water Cooling System (WCS) 6-6
    Service Sockets (Reserve) 6-6
    Circuit Breaker Control 6-7
    24 V Control Voltage 6-7
PDC Power Control 6-9
    System ON (GANTRY ON) 6-9
    Computer on (Gantry OFF) 6-10
    Computer off (Computer Rack) 6-10
    Service Switch S1 6-11
    Service Switch S2 6-11
Direct Current Circuit (DCC) 6-13
    Capacitor Bank Charging 6-13
    Charge Indicators 6-13
    External Connections 6-15
    Power supply 6-15
    Serial Linked Input Output (SLIO) Board 6-15
    Signals 6-16

Chapter 7
WCS

Functional Description 7-1

Water Cooling System (WCS) Types 7-1
  Water-Water Cooling Unit 7-1
  Water-Air Cooling Unit 7-1
Water-Water Cooling Unit 7-2
  Water-Water Cooling Unit Water Circuit 7-5
  Water-Water Cooling Unit Electrical Circuit 7-8
Water-Air Cooling Unit 7-12
  Water-Air Cooling Unit Water Circuit 7-14
  Water-Air Cooling Unit Coolant Circuit 7-16
  Water-Air Cooling Unit Air Flow 7-19
  Water-Air Cooling Unit Electrical Circuit 1 7-21
  Water-Air Cooling Unit Electrical Circuit 2 7-27

Parts Replacement 7-29

Water-Water Cooling System Overview 7-31
Water-Air Cooling System Overview 7-32
Draining and Filling the Cooling System 7-33
  Draining the Cooling System 7-33
  Draining Process 7-34
  Additional Procedures 7-35
Filling the Water Cooling System 7-37
  Final Steps 7-42
  Checking the Correct Pump Rotation in the Water Cooling System (WCS) 7-43
Replacing the Permanent Bleeding Valve (Water-Water only) 7-44
  Removing the Valve 7-44
  Installing the Valve 7-45
  Final Steps 7-46
Coolant System (Water-Air only) 7-47
Spirovent Bleeding Device 7-48
  Removing the Bleeding Device 7-48
  Installing the Bleeding Device 7-49
  Final Steps 7-50
Temperature Sensor 7-51
  Removing the Temperature Sensor 7-51
  Installing the Temperature Sensor 7-52
  Final Steps 7-52
Adjustment Drive in the WCS (Water-Water only) 7-53
  Removing the Adjustment Drive 7-53
  Installing the Adjustment Drive 7-55
  Final Steps 7-55
3-way Valve (Water-Water only) 7-56
  Removing the 3-way Valve 7-56
  Installing the 3-way Valve 7-57
  Final Steps 7-58
Cooling Pump 7-59

- Removing the Cooling Pump 7-59
- Installing the Cooling Pump 7-61
- Final Steps 7-61
- Checking the Correct Pump Rotation in the Water Cooling System (WCS) 7-62

Expansion Reservoir 7-63
- Removing the Expansion Reservoir 7-63
- Installing the Expansion Reservoir 7-65
- Final Steps 7-65

Flow Sensor (Water-Water only) 7-66
- Removing the Flow Sensor 7-66
- Installing the Flow Sensor 7-67
- Final Steps 7-67

Filling and Draining Valve 7-68
- Removing the Filling and Draining Valve 7-68
- Installing the Filling and Draining Valve 7-69
- Final Steps 7-69

Shut-off Valve 7-70
- Removing the Shut-off Valve 7-70
- Installing the Shut-off Valve 7-71
- Final Steps 7-71

Temperature Sensor in the Air Inlet (Water-Air only) 7-72
- Removing the Temperature Sensor 7-72
- Installing 7-73
- Final Steps 7-73

Fan (Water-Air only) 7-74
- Removing the Fan 7-74
- Installing the Fan 7-76
- Final Steps 7-77

Chapter 8
Network Configuration

Network Installation and Configuration 8-1

Mx8000 Network Configuration 8-3
Network Configuration Terminology 8-5
Using the Configuration Dialog Boxes 8-7
    Setting the IP Address 8-8
    Routing and Gateway 8-9
    Display Actual Current Ethernet Speed (10/100) 8-11
    Configuration Procedure 8-12
    Backing Up LAN Configuration Files to a Floppy 8-12
    Backing Up LAN Configuration Files to an EOD 8-13
    Adding Nodes 8-14
    Removing Nodes 8-14
    Opening the Node Configuration Dialog Box 8-14
    Device Configuration 8-17
    Adding HIS/RIS to the Mx8000 8-28
    Configuration Instructions 8-29
Site Manager 8-31
    Overview 8-31
    Configuring the Mx8000 to Recognize the SiteManager 8-32
    Configuring the SiteManager to Recognize the Mx8000 8-34
Device Configuration 8-35
Mx8000 Workstation Export Function 8-47
    Creating an Export Device (Configuration) 8-47
    Exporting Images to a Floppy, or a DICOM Station 8-49
    Exporting images Directly to the EOD 8-50
    Transfer Syntax 8-51
Mx8000 Workstation Import Function 8-52
    Creating an Import Device (Configuration) 8-52
    Importing Images 8-52
    Transfer Syntax 8-53
LAN Configuration in MxTwin Station Connected to Mx8000 Workstation 8-54
Mx8000 LAN Configuration Features 8-56
    Pushing Images from MxTwin to the Mx8000 (without a PassPort) 8-56
    Pushing Images from a MxTwin Scanner to a Foreign DICOM Workstation Using the Mx8000 as a Transparent Gateway 8-65
Network Connection Testing and Troubleshooting 8-69
    Network Testing 8-69
    Diagnosing Software Problems 8-75
    Disabling the Workstation Password 8-75

Chapter 9
Cabling

Cabling 9-1

Abbreviations 9-2
System Cabling 9-3
    System Cables List 9-4
Gantry Stationary Cabling 9-8
    Gantry Stationary Cables List 9-9
Gantry Rotating Cabling 9-25
    Gantry Rotating Cabling List 9-26
Ground Rules 9-34
    Overview 9-34
    High Voltage Circuit 9-35
    CAN Bus Wiring 9-35

Chapter 10
System Options

AMC-4 Option 10-1

Installing the AMC Device (AMC-4 Option) 10-1
- Location 10-1
- Power Supply 10-1
- Connecting the Cables 10-2
- LED Indicators 10-5
- Internal Jumper Configuration 10-6
- Declaring the AMC-4 as an Mx8000 Device 10-7
- Testing The AMC 10-7

CEXT Option 10-9

- Parts 10-10
- Tools 10-13
- Estimated Time 10-13

Installation Procedure 10-13
- Removing the W865 Cable from the Rack 10-13
- Removing the W865 Cable from the Console 10-16
- Installing the W870 Cable 10-18

Cardiac Prospective Gating 10-19

Prerequisite 10-19

Parts 10-20

Tools 10-20

Estimated Time 10-20

Setting Up the ECG Unit 10-21
- ECG Monitor Battery 10-21
- Voltage Supply 10-21

Final Steps 10-24

CCT Site Preparation 10-25

Safety Notes 10-26

Site Preparation Prerequisites 10-27
- Ceiling Height: 10-27

Support Column Positioning 10-28
- For Existing Mx8000 Systems 10-28
- For Mx8000 Systems Not Yet Installed 10-29

Structural Details 10-30

Seismic Anchorage With Ceiling Plate 10-31

Load Calculation: Ceiling—Mounting Plate 10-32

Cable Ducts and Routing 10-34

CCT Installation 10-35

Tools Required 10-35
Estimated Time 10-35
Preface 10-35
Prerequisite 10-36
Parts 10-36
Assembly Procedure 10-38
  Server Base Assembly 10-38
  Server Base Mounting 10-40
Footswitch Installation 10-42
  Installation 10-42
Overhead Monitor Option 10-43
  Monitor Arm Assembly 10-43
  Monitor Cable Connections 10-45
Cart Monitor Option 10-47
  Cart Assembly 10-47
Final Checks 10-50
Troubleshooting 10-51

IRS Upgrade to 24 SHARCS 10-52

General 10-52
Parts 10-52
Tools 10-53
Estimated Time 10-53
IRS Installation Procedure 10-53
  System Setup 10-53
  Setting the Expansion Cards to 16 MB Window Size 10-58
Post Programming Procedure 10-60
  PCI Link Card 10-62

MEM-8 Option 10-64

Parts 10-64
Installation Instructions 10-65
  O2 Memory Banks - General Description 10-65
  Installation Procedure 10-66

21" Remote Slave Monitor Option 10-67

Safety Information 10-67
  Precautionary Measures Regarding Electrical Voltage 10-67
Tool Required 10-68
Estimated Time and Manpower 10-68
Preface 10-69
  Parts 10-69
Video Amplifier Assembly 10-71
  Assembly Procedure 10-71
Remote Slave Monitor Assembly 10-75

UPS (Uninterruptible Power Supply) Option 10-76

Parts 10-76
Tools 10-77
Estimated Time 10-77
Procedure 10-77
Tests 10-79

SAS (Spiral Auto Start) 10-80

Prerequisites 10-81
Tools 10-84
Time 10-84
Parts 10-84
Procedure 10-85
Connection of External Cable MCU/RTC X25 to the Injector . . . 10-85
Medrad Envision Injector Test 10-87
Test Objectives 10-87
Test Plan 10-87
CANpro Verification 10-87
Medrad Visitron Injector Test 10-88
Test Objectives 10-88
AutoLink Test 10-88
Test Plan 10-88
CANpro Verification 10-89
Liebel Florsheim CT9000 ADV Injector Test 10-90
Test Objectives 10-90
Test Plan 10-90
CANpro Verification 10-90
Liebel Florsheim Angomat Injector Test 10-91
Test Objectives 10-91
Test Plan 10-91
CANpro Verification 10-91
Injector Cable and Wiring Diagrams 10-92

Chapter 11
Stop Report

Stop Report 11-1

Introduction 11-1
Stop Report Loop 11-2
    Overview 11-2
    StopRepIn/Out loop 11-2
    StopPos/Neg Circuit 11-2
System/MCB 11-5
Closing the Stop Report Loop 11-8
Opening the Stop Report Loop 11-9
The Stop Report Troubleshooting Kit 11-11
    Bypass Connectors 11-11
Pin Layout (Short-Circuit Connectors) 11-12
    Workstation 11-12
    Rotor 11-12
    Couch 11-13
    GPC 11-13
    PDC (D451+SLIO) 11-13
    Gantry Stop Buttons 11-14
    Slice Counter 11-14
    XRS (Connector on W560 Cable 11-14
How to Use the CANpro Program to Locate the Defective Component 11-15
    Analyzing the Results 11-17
Troubleshooting 11-18
Cables and Pin Layout 11-21
Installing the Troubleshooting Scenarios From the Diskette 11-22
    Running the Scenarios 11-22
Stop Circuit-Details 11-23
Service Switches/Push Buttons 11-24
Troubleshooting Step-By-Step—Flowchart 11-27
    Step 1: Checking the Workstation 11-27
    Step 2: Checking the Rotor 11-28
    Step 3: Checking the XRS 11-28
    Step 4: Checking the Couch 11-29
    Step 5: Checking the GPC Board 11-30
    Step 6: Checking the PDC Board 11-31
    Step 7: Checking the Stop Buttons 11-32
    Step 8: Checking the Slice Counter 11-33
    Step 9: Checking the MCU Board 11-34
Final Steps 11-34
Stop Report Checklist 11-35
Recommended Spare Parts 11-36

Stop Report Cable Pin Layout 11-37

Cable W51 11-38
Cable W51 11-39
Cable W52 11-40
Cable W351 11-41
Cable W362 11-42
Cable W364 11-43

Chapter 12
Service Tools

Service and Calibration Tools 12-1

Service Tools and Calibrations 12-1
Service Menu Organization 12-1
    General Information About Physics Calibrations 12-1
Z-Alignment Calibration 12-2
    Z-Alignment Control Function 12-2
    Z-Alignment Calibration Menus 12-2
    Z-Alignment Calibration Procedure 12-5
Slice Normalization 12-5
Air Calibration 12-5
XRT – DFS Calibration 12-6
    DFS Calibration Application 12-6
XRT - Filament Calibration 12-8
XRT - Current Calibration 12-9
    UHR (Ultra-High Resolution) 12-10
Phantom Calibration 12-11
Temperature Display 12-12
Tube History Display 12-13
The Error Log Analyzing Tools 12-14
    Using LogViewer 12-14
    Using LogOnline 12-16
    Using the Error Log 12-16

Communication (Data Path) Troubleshooting 12-18

    Introduction 12-18
    Data Path Field Replaceable Units (FRUs) 12-19
    ACQ_OK 12-20
    Data Path Block Diagram 12-21
    ACQ Card Communication LEDs 12-22
    General Tips 12-25
    Error MCU 00 00 54 12-27
    Bypass Procedure 12-29
Capacitor Ring Test Procedure 12-31
    General 12-31
    Preparations 12-31
    Electrical Test 12-34
    Visual Capacitor Ring Inspection 12-35
    Replacing the Funnel 12-36
Avoiding ESD Damage to Gantry Receivers and Transmitters 12-37
    Overview 12-37
    Receiver / Transmitter Kit 12-38
    Procedure 12-39

Chapter 13
CANpro

CANpro 8.1 Service Instructions 13-1
Overview 13-1
Folder Structure 13-2
  Folders Downloaded from Site 13-3
  Scenarios Folder 13-4
  Important Note 13-5
CANpro Version 8.1 Installation Instructions 13-1
introduction 13-1
Prerequisites 13-2
  Parts Required 13-2
  Important Notes 13-3
Uninstalling CANpro Secure 4.8 Diagnostic Software 13-4
  Initial Conditions 13-4
Procedure 13-5
Pre-Setup installation for Windows 98 Systems 13-6
Pre-setup Installation for Windows 2000 Systems 13-9
Installing CANpro Can Test Tool Software 13-14
  Install CAnpro, Device Drivers & Machine Description 13-14
  Define Hardware for the Peak Can Device Driver 13-19
Ethernet Setup 13-21
  Introduction 13-21
  Procedure 13-23
Network Verification 13-27
  Initial Conditions 13-27
  Procedure 13-27
Connecting to the Scanner for the First Time 13-29
Updating CANpro 13-31
CANpro CAN Test Tool User’s Guide 13-34
Introduction 13-34
  Definitions 13-35
Getting Started 13-41
  How Does Canpro Run in Real-time on Windows 98/ME/NT/2000? 13-48
Safety Aspects of CANpro Use 13-50
  Thermal Load Calculator (Heat Calculator, TLC) 13-51
CANpro User Interface 13-52
  Menu Commands 13-53
  Shortcut Toolbar 13-70
  Status Bar 13-72
CAN Operation 13-73
  CAN Telegram Monitoring 13-73
  CAN Telegram Simulation 13-76
  Loading and Checking Scenario Files 13-77
  Scenario File Execution 13-78
CANpro User Tips 13-84
  Evaluating Protocol Files on a PC without any CAN Card 13-84

Performing Long-Term Monitoring during One or more Weeks . . 13-84

Continuing a Sequence of Autonumbered Protocol Files 13-85

Flash Load and Read 13-86

Loading Firmware to the Gantry 13-87

Reading Firmware from the Gantry 13-90

Updating CANpro with Firmware Versions 13-94

Updating CANpro with Additional Error Documents 13-95

Troubleshooting 13-96

Initialization Errors 13-96

Error Message when Exiting CANpro or Changing the Machine while a Scan is Running 13-99

CANpro Cannot Send or Receive Telegrams 13-99

Memory Problems 13-100

Disk Space Problems 13-100

CAN Driver or Card Errors 13-100

Chapter 14
Software Installation

Software Version 2.51 Full Installation 14-1

How This Chapter is Organized 14-2
Software Media 14-4
  Installation Procedure Prerequisites 14-4
Installation Procedure General Description 14-7
  Mx8000 Software Version 2.51 Installation Using Backup/Restore of System Tables 14-7
  Mx8000 Software Version 2.51 Installation Without Using System Tables Backup/Restore 14-8
  Note on UNIX IRIX 6.3 Installation Procedure 14-9
System Tables Backup Instructions 14-10
  System Tables Backup 14-10
  Network Verification (For Systems With External Devices Connected Through a Router) 14-11
UNIX IRIX 6.3 Operating System Installation with Hard Disk Format . 14-12
  Hard Disk Format Procedure 14-13
  UNIX IRIX 6.3 Operating System Installation After Hard Disk Format 14-16
UNIX IRIX 6.3 Operating System Installation Without Hard Disk Format 14-21
  Prior to the UNIX IRIX 6.3 Operating System Installation 14-21
  UNIX IRIX 6.3 Operating System Installation 14-25
UNIX IRIX 6.3 Patches Installation 14-28
USP V1.52: Installation Instructions 14-30
Mx8000 Version 2.51: Installation Instructions 14-33
System Tables Restore Instructions 14-34
  System Tables Restore 14-34
  Verifying Network Settings 14-34
  Default Device Storage List 14-35
Hardware Dependant Tables Completion 14-36
  System Tables General Description 14-36
  P-Plane Collimator Encoder Settings 14-36
  WCS and Tilt Motor Type Definition 14-39
System Physical Calibrations and Proper Functioning Check 14-42
  System Physical Calibrations 14-42
  HIS/RIS Settings Verification (Only for Sites using HIS/RIS) 14-43
  Service (IRS) Diagnostic Key Installation 14-44
  System Proper Functioning Check 14-44
Mx8000 System Network Configuration 14-45
Final Steps 14-46
  System Performance and Image Quality Check 14-46
  Version 2.51 System Tables Backup 14-46
License Keys 14-47
  Entering an Option License Key (from a printout) 14-47
  Verifying the System Options 14-47
  Entering Service (IRS) Diagnostic Key 14-47

xfscopy 14-48

Chapter 15
Image Quality

Preface 15-1

Procedure for Image Quality Problem Analysis 15-2

Tool/Procedures for Analyzing Image Quality Problems 15-4
GI (Gated Integrator Card) 15-5
Rings 15-6
Procedure for Ring Analysis 15-8
Bias Checking 15-12
Bands 15-13
Streaks 15-13
Replacing Single Detector Modules 15-14
UH Collimator Adjustment 15-16
High Resolution DFS Calibration 15-18
Ultra High-Resolution Calibration 15-20
Mechanical Adjustment Procedure 15-23
Prepare for Retesting 15-24
Completion Procedure 15-24
Ultra High Resolution Pre-alignment with X-ray Film 15-25
Other Artifacts 15-30
Arcing Problems 15-30
Reconstruction Problems 15-30
Software Problems 15-31

FEE Bias Test 15-32

General 15-32
FEE Bias, Noise, Leakage, and, Signal Test Instructions 15-33
Scans Without X-ray 15-33
Scans in Air With X-ray 15-37

Reference Detector Assembly Check 15-40

General 15-40
Procedure 15-41
Scans Without X-ray 15-41
Scan With X-ray 15-44

Replacing a Six Module Set 15-45

General 15-45
Procedure 15-46

Miscellaneous 15-51

Bad Detector Table 15-51
GI Card Replacement 15-51
A Band on Body Image 15-52
Phantom Calibration 15-52
Single Module Replacement 15-52

Cleaning Detector QS Modules with ACL Staticide Wipes SW-12 15-53

Introduction 15-53
General 15-53
Safety Measures When Using ACL 15-54
First Aid Measures 15-54
Cleaning Procedure 15-55
    Preparations 15-55
    Cleaning 15-56
Examples of Real Problems 15-60

GI/Module Table 15-61

Appendix A
Electrical Line Inspection 15-62

    Line Impedance Measurement Kit P/N 453566454111 (PMSTL P/N 407-7181-8008) 15-62
    Test Instruments Required 15-62
    Estimated Time 15-63
Test Procedure Preparation 15-64
Measurement Checklist and Corrective Actions 15-69
    Nominal Line Parameters 15-69
    Measured Values on TEAL (PLC)/WDC Input 15-71
Corrective Action 15-75
Measured Values on PDC Input 15-77
Corrective Action 15-82

Preface

Definitions and Abbreviations

The following abbreviations are used in this chapter:

CT Terms

ASIC	Application Specific Integrated Circuit
DFS	Dynamic Focal Spot
FEE	Front End Electronics
FFS	Flying Focal Spot
PREP	Pre-processed raw data—a step in the reconstruction
ODL	Optical Data Link
RAW	Header and Data of one scan
Reading	The values of all detectors received at the same angular and focal position
Row	Detectors Row. The detector assembly is built from "n" rows of detectors where "n" is 2, 4, 8, or 16 rows.
Sample	A single measurement by one detector element during an integration period
Sampling Density	A parameter describing the number of fans per rotation
Scan	The process of taking measurement data (make_data signal is on).
Slice	672 Detectors along the X axis of the DMS, (with the same Z coordinate). The DMS has 16 Slices.
Subfan time	Integration time
Subfan/Reading	A set of samples measured in one integration period by one detectors row
View/Frame	A set of samples describing the attenuation data of one detector row for a given rotation angle

CT Sub-assemblies

ACQ	Acquisition card, in the IRS, receives the measurement data (FEE data) from the DMS
ADM	Array Detector Module—assembly of PDA + ADM_Card + AS + Support mechanics + Cables
ADMC	Array Detector Module Card—Mx8000 and Mx8000 Dual PCB with 8 ASICs and electronic components (excluding PDA)
ADU	Acquisition Control and DOM Unit A board in the CBOX—responsible for the communication to DMS
AS	Anti-Scatter collimator
CBOX	Rotor control box—contains the communication and the power supply to DMS
DAS	Data Acquisition System (Detectors, ADMC boards and RCOM board)
DMB (MB)	DMS motherboard—consisting of the LMB (Left) and RMB (Right)
DMS	Data Measurement System
DOM	Dose Modulation unit—used for HV power modulation
DPU	A board in the C-BOX—responsible for power supplies to the DMS
Host	The Host computer
IRS	Image Reconstruction System—receives the FEE data and reconstructs it to image
LMB	Left motherboard
RMB	Right motherboard
PDA	Photodiode Array (silicon segmented array + MUX + Ceramics + Connector)
RCOM	Communication and Control card in the DMS.
Ref_Conv	Reference Converter, a unit that converts the reference detector analog readings into digital
TCC	Temperature Control circuitry
UHR	Ultra-High Resolution Collimator
XRS	X-Ray System
XRT	X-Ray Tube

General Terms

FDA	U.S. Food and Drug Administration

Standard FSE Tool Kit

The following table lists the standard tools necessary for servicing the Mx8000 IDT. Special tools required for specific procedures are listed with those procedures.

P/N	DESCRIPTION	QTY
Local purchase	Electronics Phase Sequencer (Same as for Installation)	1
Local purchase	Torque wrench 25-130 Nm with 1/2” Drive	1
Local purchase	Fork wrench, size: 5, 17, 27, 32, 36 and 42.	Set
Local purchase	1/2” Drive Ratchet for items 12, 13 below	1
Local purchase	1/2” Drive Extension-Length 150 & 300 mm	Set
Local purchase	1/2” Drive Allen bit socket set: 3–14 mm	Set
Local purchase	1/2” Drive Hex socket set: 6–18 mm	Set
Local purchase	1/2” flexible Water hoses 15m long (same as for installation)	2
Local purchase	1/2” Tube clamps	2
Local purchase	Set of Allen Keys, 1.5–10 mm	Set
Local purchase	Vacuum Cleaner	1
Local purchase	Crimper – WAGO PN: 206-216 or equivalent.	1
CP00429100B	9.1 GB, 1024 Bytes/Sector Optical Cartridge	1
SP700000001	ESD protection kit	1

P/N	DESCRIPTION	QTY
SP 000335077	Anti Static Kit	1
Local purchase	2.5mm Allen Hex socket for ¼” Drive	1
Local purchase	Power bit Adapter driver 1/4"	1
Local purchase	Right Angle power CP Screw driver Max Torque 100 in/lbs Driver 1/4" hex	1
Local purchase	Set of TORX keys	
Local purchase	2.0mm Allen Hex socket for ¼” Drive	1
SP71-1621-791	H.V Dummy Plug	1
Local purchase	Spring Balance 30-600 Nm	1
Local purchase	Spring Balance 200 Nm	1
Local purchase	Grease SOFLEX TOPAS NCA52 - By Kluber	1
Local purchase	High pressure grease gun	1
Local purchase	Heat sink grease	1
SP000118124	Silicon Oil	1
SP000118123	Silicon Washer 3P	2
Local purchase	Set of Allen Keys, 1.5-10 mm**(1)**	Set
Local purchase	1/4” Drive Hex bit socket set 2-6 mm	Set
Local purchase	Bit for flat screw M3 - Fits to 1/4” Drive	1
Local purchase	Torque wrench 3-20 Nm with 3/8” Drive	1
Local purchase	Torque wrench 10-50 Nm with 3/8” Drive	1
Local purchase	Torque Screw Driver 40-200 Ncm with 1/4” Hex Drive	1

P/N	DESCRIPTION	QTY
Local purchase	Power Shank Adapter- 1/4” Hex to 1/4” Square Drive Length 50 mm - for the Torque Screw Driver	1
Local purchase	Adapter for Torque Meter, from 3/8” to 1/4” Drive	1
Local purchase	1/4” Drive Extension - 50 and 150 mm length	1
Local purchase	Torque wrench 25-130 Nm with 1/2” Drive	1
Local purchase	Open-end wrench, size: 27, 32, 36 and 42.	Set
Local purchase	1/2” Drive Ratchet for items 39,40,41 below	1
Local purchase	1/2” Drive Extension-Length 150 & 300 mm	2
Local purchase	1/2” Drive Hex bit socket set 7-14 mm	Set
Local purchase	1/2” Drive socket set 6-18 mm	Set
Local purchase	Feeler Gage Metric	1
Local purchase	Vacuum Cleaner	1
Local purchase	Laptop for Advanced Diagnostics Software (CANpro) and Service Documentations.	1
Local purchase	100 MHZ Memory Scope	1

Chapter 1
General

Safety Guidelines 1-1

Overview 1-1
General Precautions 1-2
  General Service Safety Procedures and Information 1-2
  Explanation of Symbols 1-3
  Electrical Installations 1-3
  Installation of Electro-medical Systems and Equipment 1-3
  Personal Protection Measures (Occupational Safety) 1-4
Service Precautions 1-8
  Precautions Against Mechanical Hazards 1-9
  Precautions Against Electrical Hazards 1-11
  Precautions Against Radiation Hazards 1-12
System Specific Safety Precautions 1-13
  Working with System Components 1-13
Attaching Screws and Nuts 1-18
  Tightening Torques for Screw Connections 1-20
  Using LOCTITE 1-21
ESD (Electrostatic Discharge) 1-23
  ESD—Anti-Static Field Service Kit 1-24
  Purpose 1-24
  Tools 1-24
  Parts 1-24
  Procedure 1-26
  Connecting the ESD Field Service Kit 1-29

Safety Guidelines

Overview

This chapter describes safety precautions and procedures that will ensure the safety of everyone during servicing and operation of the Mx8000 system and includes the following sections:

- General precautions to be observed at all times
- Service precautions to be observed primarily when the equipment is serviced
- Description of the warning labels

READ ALL SAFETY INFORMATION VERY CAREFULLY. THIS KNOWLEDGE COULD SAVE LIVES.

Left and right references are from the point of view of a person standing at the open end of the Patient Table, facing the Gantry (see *Figure 1-1*).

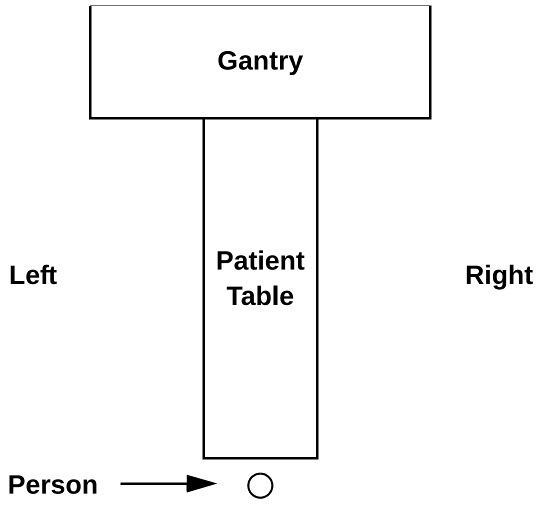


Figure 1-1: Left and Right References

General Precautions

This product was designed and manufactured to ensure maximum safety of operation and service. It should be installed, maintained, and serviced in strict compliance with the safety instructions contained herein.

1. No changes, additions, or removal of any system accessories are permitted without the prior written approval of a local service manager.
2. Connect the product to the mains according to the wiring scheme in this manual.
3. Before beginning any clinical use, complete all safety checks in this manual.
4. Do not leave problems unsolved that may affect the safety of the product. In case of doubt concerning the system's safe operation, call the service manager for further instruction.
5. Do not allow unauthorized personnel access to the system. Only properly trained and fully qualified personnel are authorized to install and operate this equipment.
6. Leave the site clean and orderly.

General Service Safety Procedures and Information

Please keep the following in mind at all times:

1. The system has three red STOP buttons that halt all Gantry and Patient Table motion, as well as X-Ray generation. Two buttons are on the Gantry’s front cover, one on each side. The third is on the CT-Box connected to the Operating Console.

⚠ **CAUTION**

PRESSING THESE STOP BUTTONS ***DOES NOT*** DISCONNECT THE POWER SUPPLY TO THE SYSTEM.

2. Whenever you service the machine, remove everyone from the Gantry room who does not have to be there.
   If you are not alone (you are working with another person):
   - Define who is in charge, and coordinate your work with the other person.
   - Say what you are going to do out loud, and make the other person confirm your declaration by repeating your words.

Explanation of Symbols

Symbols used in the technical documents have the following meanings:

⚡	Measuring and adjusting work on parts which are under a voltage of >50 VAC or >120 DC.
☢	Activities with radiation switched ON.
⚠	Safety-relevant screw connections. Use only the (supplied) screw connections which are suitable for the intended purpose and tighten with the specified torque.

Electrical Installations

Electrical installations of medically used rooms must be made in accordance with the requirements of each country.

The regulations must be taken from the installation sheets for the project concerned.

Installation of Electro-medical Systems and Equipment

All work must be carried out in accordance with the technical documentation.

Make sure that all **protective ground wires** provided by the manufacturer are connected properly before starting the equipment after installation. This applies, for example, to all metallic covers which may develop a dangerous contact voltage in case of a fault. They must always be connected to the protective ground wire. To ensure this, the connection between these covers and the protective ground wire must be made with screws and contact washer or via the protective ground wires provided.

⏚	Means "**Terminal for connection of equipment protective ground wire**".

The protective ground wires must be connected between the system components and the power supply as shown in the wiring diagram.

In the interest of protection for our personnel, the protective ground wires must be installed prior to first switching on the product/system, as well as after completing all work, before turnover to the customer, in accordance with the product documentation.

Perform the Electrical Line Inspection procedure before turning the system ON (see *Appendix A: Electrical Line Inspection*).

Personal Protection Measures (Occupational Safety)

The legally relevant and internal regulations and specifications concerning protection of labor and accident prevention must be observed, primarily in the interest of the persons performing the work. The notes below are given as additional information.

Mandatory Reporting

The supervisor in charge must be notified at once in the event of an accident or if there are any hazards which may cause an accident.

Working when Connected to Voltages

No work must be performed on current-carrying parts (>50 V ~ or 120 V).

The system must be de-energized by means of the EMERGENCY OFF switch.

This prohibition does not apply for measuring and adjustment procedures. Be careful when performing these procedures. Use only tools and measuring instruments which are suitable for the respective procedure.

Test and adjustment points must be accessible without any risk of injury for the personnel. If this is not possible, switch OFF the system.

If voltage must be applied during an operation, e.g., to perform unit movements, take every precaution especially when working with moving and rotating parts. De-energize the unit immediately afterwards.

⚠ CAUTION

WHEN PERFORMING WORK WITHIN THE DANGER AREA OF PRODUCTS, ANY INVOLUNTARY UNIT MOVEMENTS MUST BE PREVENTED BY PREVIOUSLY ACTUATING THE SERVICE SWITCH OR THE EMERGENCY STOP BUTTON

Radiation Protection

Ionizing radiation can lead to radiation injuries if handled incorrectly. When radiation is applied, the required protective measures must be complied with in any event.

Laser Radiation

All lasers are classified by the manufacturer and labeled with the appropriate warning labels. Any modification of an existing / unclassified laser must be classified by the Laser Safety Officer prior to use. The following criteria are used to classify lasers:

- **Wavelength**. If the laser is designed to emit multiple wavelengths the classification is based on the most hazardous wavelength.
- For **C**ontinuous **W**ave (**CW**) or repetitively pulsed lasers the average power output (Watts) and limiting exposure time inherent in the design are considered.
- For pulsed lasers the total energy per pulse, pulse duration, pulse repetition frequency and emergent beam radiant exposure are considered.

There are four different classes of lasers. The lasers in our systems are:

Class 2 (Visible Lasers: 540–700 nm, peak power < 1mW)

Lasers emitting visible light not intended for viewing, and under normal operating conditions would not produce an injury to the eye if viewed directly for less than 1000 seconds_ bar code scanners.

General Safety Precautions

- Laser products may not be operated without the appropriate housing.
- Only instructed co-workers are allowed to handle lasers. When working with lasers, observe all legal and product specific regulations (T1 242).
- Do not look directly into the laser beam or at its reflection on smooth, mirror-like surfaces.
- Non-compliance with legal regulations can lead to bodily injury due to the hazardous effects of the laser beam.

Batteries

For replacement of batteries, special preventive measures apply. In the case of lithium batteries, there is as risk of explosion if they are incorrectly installed. The notes concerning handling and disposal must be observed in each case.

Do not expose batteries to fire; they may explode.

Do not use a knife to destroy a battery. The released electrolyte is harmful to your skin and eyes.

Obey the following warnings when working with batteries:

- Remove watches, rings, or other metal objects.
- Use tools with insulated handles.
- Wear rubber gloves and boots.
- Do not place tools or metal parts on the batteries.
- Disconnect charging source before connecting or disconnecting battery terminals.
- Check whether the battery was carelessly grounded. If so, remove it immediately. Contacting with any part of a grounded battery can result in electric shock.

Handling Heavy Loads

Apart from wearing the required protective clothing, e.g., safety boots and gloves, care must be taken that heavy loads are correctly lifted or carried to avoid any physical injury (e.g., injuring the spine).

The relevant instructions must be complied with. Heavy or awkward loads must be moved by mechanical means or by several persons.

Handling Hazardous Substances

Hazardous substance is the designation for materials which can ignite or explode or which are toxic, injurious to health, corrosive or irritating.

Their properties together with the hazards and protective measures connected with them are identified clearly by symbols and described by the instructions appertaining to the hazardous substances.

Before they are handled, these instructions must be read and the required protective measures must be complied with when performing work to avoid health risks.

In addition, all relevant instructions in the documentation must be complied with.

Blood-borne Pathogens

WARNING

BIOHAZARD! INFECTION THROUGH BLOOD:

WHEN HANDLING PARTS THAT MAY HAVE COME INTO CONTACT WITH PATIENTS, TAKE APPROPRIATE ACTIONS AGAINST EXPOSURE TO BLOOD-BORN PATHOGENS.

Service Precautions

Safety precautions must be taken before servicing the machine. It is the ***responsibility of the service engineer*** to ensure that these precautions are taken to avoid any hazard.

There are three different kinds of potential hazard when servicing an instrument like the Mx8000:

- Mechanical hazards
- Electrical hazards
- Radiation hazards

Precautions Against Mechanical Hazards

WARNING

ROTATING MACHINERY— NEVER SERVICE THE ROTATING FRAME WHEN OR IF ROTATIONAL MOVEMENT IS ENABLED. FAILURE TO COMPLY MAY RESULT IN EQUIPMENT DAMAGE, SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

The following precautions prevent mechanical hazards:

1. The Rotor of the Mx8000 contains heavy parts, such as the High Voltage Power Supply, DMS, etc., and is perfectly balanced. When you disturb this balance by removing a part from it, it will start an uncontrolled mechanical motion to reach a new equilibrium point. This motion cannot be stopped and may injure the service engineer.
   Therefore, ***if you intend to remove a unit, proceed as follows:***
   a. Bring the Rotor to the position in which the unit can be removed.
   b. When the Rotor is not rotating, engage the rotor locking device (located on the front side of the Gantry at the 2 o’clock position—see *Figure 1-2* and *Figure 1-3*).
   c. Do not release the rotor locking device until the unit (or its replacement) is returned and fixed securely to the Rotor.

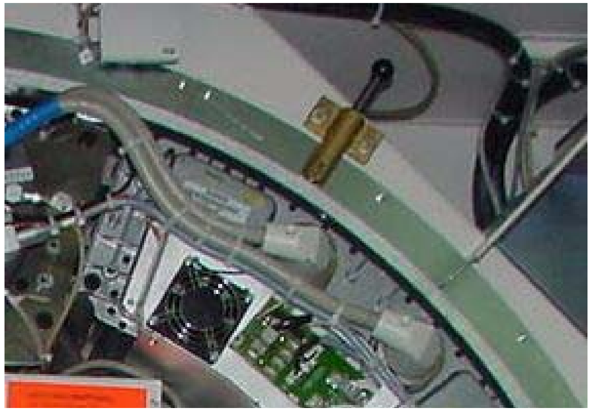


Figure 1-2: Location of Locking Pin

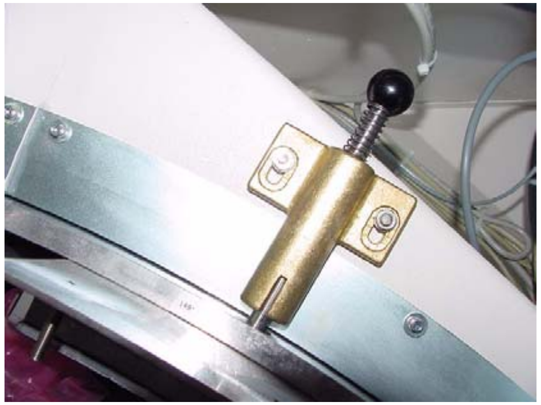


Figure 1-3: Locking Pin Engaged

2. In its idle state, the Mx8000 rotates most of the time; consider all units mounted on the rotor as ***flying*** units. If you fail to fasten units to the Rotor securely or leave loose screws, units may detach from the Rotor and cause serious injury. After servicing any unit, verify that all units and screws are attached securely in their correct places.
3. The Rotor has no fixed idle position, and even when it is not generating X-Rays it may start rotating. An uncontrolled, electricity-driven rotation may cause serious injuries. For this reason, two microswitches in the front cover disable rotation each time the front cover is opened. In addition, another switch on the inner left side of the Gantry also disables rotation. Do not bypass the two front cover switches unless no person is near the Gantry, and it is absolutely necessary.

⚠ WARNING

NEVER APPROACH THE GANTRY WHEN ROTATIONAL MOVEMENT IS ENABLED.

⚠ WARNING

**POINT OF INJURY! COMPONENTS OF THE MX8000 HAVE SHARP EDGES THAT MAY CAUSE INJURY.
USE PROTECTION WHEN WORKING ON SCANNER COMPONENTS.**

Precautions Against Electrical Hazards

The following precautions prevent electrical hazards:

1. Being a continuous rotating scanner means that the power is transmitted to the rotating part by mechanical slip rings. Over the slip rings there are ***line voltages***. Once you remove the rear cover, you may be in contact with line voltages.

⚠ WARNING ⚠

ELECTROCUTION HAZARD! FRONT END ELECTRONICS IS ENERGIZED THROUGH THE SLIP RINGS EVEN WHEN YOU SWITCH OFF THE SYSTEM.
THEREFORE, BEFORE YOU REMOVE THE REAR COVER, TO AVOID ANY ELECTRICAL DANGER, SWITCH OFF ALL CIRCUIT BREAKERS ON THE POWER DISTRIBUTION CABINET (PDC), AND ON THE MAIN POWER SUPPLY TO THE MX8000.

2. The Computer Rack receives power from an Uninterruptible Power Supply (UPS) located in the Power Distribution Cabinet (PDC). This means that parts inside this unit continue to receive line voltages, even after the console or the various circuit breakers are switched OFF.
   Disconnect the power cables from the PDC that are connected to the Computer Rack before accessing these units.
3. Line voltages are always present in the Gantry’s left leg. Therefore, make sure that the left leg cover is always closed, unless otherwise necessary for service.
4. Remember that the PDC is energized even when the system is OFF. Therefore, always keep the door of the PDC closed. When you must service the PDC, first disconnect the main on-site power supply.
5. The system has large capacitors. Therefore, wait five minutes after disconnecting the power to the system before servicing the high voltage (HV) system on the Rotor and in the PDC.

Precautions Against Radiation Hazards

WARNING

ALL NECESSARY RADIATION PROTECTION MEASURES MUST BE PERFORMED PRIOR TO RELEASING RADIATION.

ALL PERSONNEL WORKING ON THE INSTALLATION MUST WEAR A DOSIMETER TO MONITOR THEIR RADIATION EXPOSURE.

WARNING

RADIATION HAZARD! FOLLOW THE GUIDELINES LISTED BELOW.

Observe the following protective measures when working on the scan unit with radiation ON:

- Use a radiation shield.
- Maintain a safe distance from the source.
- Use the minimum dose and the smallest slice thickness.
- Remove the phantom, if possible.

System Specific Safety Precautions

Working with System Components

Protection of Electrostatically Sensitive Devices

The used integrated circuits and PC boards, which are equipped with electronic modules require special careful handling because of their electrostatic sensitive structures and their extremely high input impedances.

Use the indicated means of protection. Refer to the section on ESD protection in this chapter.

Gantry

Before beginning any operations on the Gantry, do the following:

1. Wait until rotation has completely stopped.
2. Disable Gantry rotation. For this purpose, set switch S301 into the Gantry (left, below) to position 0.

⚠ WARNING ⚠

ELECTRICAL HAZARD! TURN THE POWER OFF FROM THE MAIN HOSPITAL BREAKER.

3. Connect the rotating and the stationary parts of the Gantry with a protective conductor, e.g., cable 4665329 B1945. When you are finished working, remove the protective conductor.

Hazardous voltage levels (560 VDC) can be present, even if the system is switched OFF. Take the following precautionary measures regarding hazardous electrical voltages:

- Keep the back of the Gantry closed.
- ***Do not*** touch the power slip rings or the carbon brush holders on the back of the Gantry.

Safety Precautions Before Opening the Gantry Back Cover

WARNING

THE SYSTEM HAS TO BE SWITCHED OFF COMPLETELY USING THE ON-SITE ON/OFF SWITCH BEFORE ANY WORK IS DONE IN THE GANTRY.

- **REMOVE FUSES F100, F200 IN THE PDC.**
- **MAKE SURE THAT THE SYSTEM IS SECURED AGAINST ACCIDENTAL SWITCH ON!**

Before working on the following part, wait until the capacitor bank is discharged (at least five minutes)! Check the two yellow LED’s on D450 inside the PDC unit.

- DCC Power D450
- Slip Rings
- Carbon Brushes
- Generator Electronics
- PSS Gantry (Measure the voltage level at X303.)

WARNING

TO ASSURE THAT THE CAPACITOR BANK IS DISCHARGED, YOU CAN MEASURE THE UDC VOLTAGE ON THE FOLLOWING POINTS:
UDC_POS AND UDC_NEG ON D450 INSIDE THE PDC UNIT
UDC_POS AND UDC_NEG ON RIGHT GANTRY STAND
UDC_POS AND UDC_NEG ON SLIP RING GANTRY REAR SIDE
UDC_POS AND UDC_NEG ON GENERATOR ELECTRONIC BOX

Generator Cabinet

⚠ CAUTION

REPLACE PRINTED CIRCUIT BOARDS IF COMPONENTS SOLDERED ONTO THE BOARD, INCLUDING FUSES, ARE DEFECTIVE.

⚠ WARNING ⚡

ONLY AUTHORIZED PERSONNEL MAY HAVE ACCESS TO THE INSIDE OF THE PDC CABINET FOR ANY REASON (TO THE F1 SWITCH).

Couch

Install both edge protectors (*Figure 1-4*) at the location indicated (arrows in *Figure 1-5*) before beginning any work on the Patient Table.

NOTE:

The two foam edge protectors are included in the system delivery volume.

Remove both foam edge protectors after completing work on the Couch. Store the foam edge protectors with the auxiliary service devices for the system.

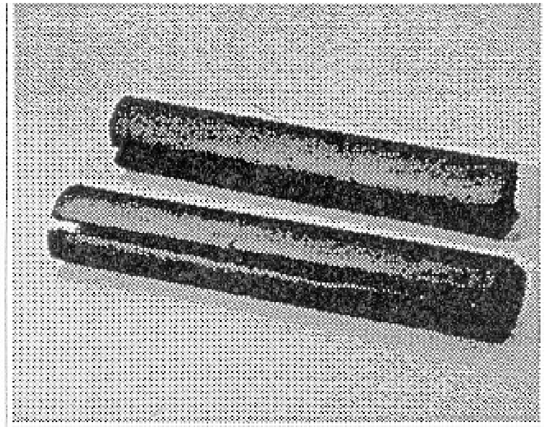


Figure 1-4: Foam Edge Protectors

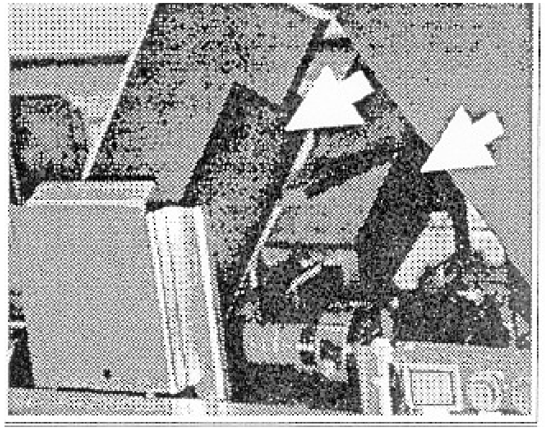


Figure 1-5: Edge Protectors Installed

Optical Disk

To ensure the reliability of the safety configuration integrated into the drive, the system may be installed or maintained only by qualified service and maintenance personnel.

The use of parts is limited to original spare parts.

Work with respect to the optical disk may be performed only in compliance with the manufacturer's instructions.

Observe the warning labels.

Warning labels may not be removed at any time (see *Figure 1-6*).

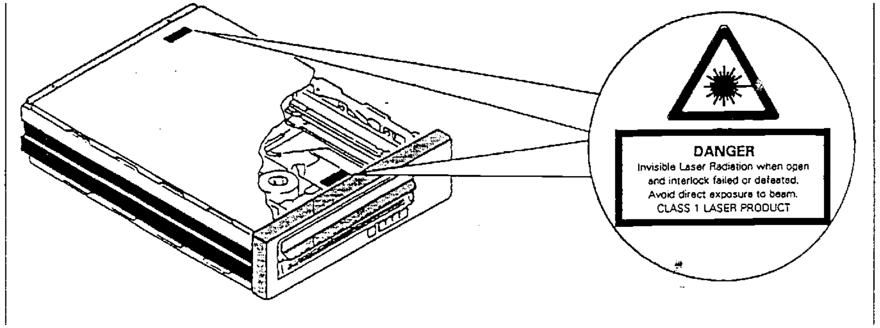

DANGER
Invisible Laser Radiation when open and interlock failed or defeated.
Avoid direct exposure to beam.
CLASS 1 LASER PRODUCT

Figure 1-6: Laser Warning Label

Light Markers

⚠ **WARNING**

LASER RADIATION HAZARD- DO NOT STARE INTO BEAM.

Specification for Laser Type FP - 67/ 1LF (LASER COMPONENTS GmbH):

- Output power <1mW
- Wave length 670 nm
- Classification according to DHHS regulations 21 CFR Chap. J / DIN VDE 0837: Class 2 Laser Product

Attaching Screws and Nuts

⚠ CAUTION

SCREW CONNECTIONS HAVE TO BE SECURED FOR SAFETY REASONS WITH A TORQUE WRENCH AND THE TORQUE LISTED (NM).

THE TORQUES FOR SAFETY-RELEVANT SCREW CONNECTIONS ARE LISTED IN THE ENCLOSED INSTRUCTIONS.

WHEN REPLACING SCREWS AND WASHERS ONLY IDENTICAL PARTS ARE PERMISSIBLE.

Fasten all screws and nuts on the rotating part of the Gantry with the torque values specified in *Figure 1-7 “Screws Used on Mx8000 Units” on page 2-20*, except screws up to M3, slotted screws and Phillips head screws, which are tightened with the wrench required and not with a torque wrench.

Tighten all screws and nuts with LOCTITE (See also, *“Using LOCTITE” on page 2-21*), except self-locking nuts, safety screws and safety nuts.

For more details, refer to the descriptions for replacement of parts.

Do not loosen or tighten safety screws and safety nuts (screws and nuts with grooves on the underside of the screw head) more than five times.

Clean dirty grooves of safety screws or safety nuts with a wire brush.

Do not use a lock washer more than once. After loosening the screw or nut, change the washer.

Do not attempt to use torque wrenches to exceed the specified torque. When the specified torque is reached, there is a clearly audible and perceptible sound and sign. Tightening the screw or nut beyond that point may destroy the screw or nut and the torque wrench. If you suspect that a screw or nut was tightened too much, change the screw or nut.

If a torque wrench has been stressed beyond a specified value, the range of the torque wrench may be corrupted. In this case, check the torque wrench and adjust it, if necessary.

When not in use, leave the torque wrench at the low setting. After prolonged non-use or storage, run the torque wrench repeatedly with a low torque; this lubricates the moving parts and improves its accuracy.

Check all torque wrenches used on Mx8000 units at regular intervals.

Tightening Torques for Screw Connections

Table 2-1 shows nominal tightening torques in Nm and wrench sizes in mm for screws and nuts with metric threads used on Mx8000 units.

Table 2-1: Tightening Torques for Screws Connections

	Strength Class 8.8						Strength Class 100					
	HEXAGON SOCKET HEAD SCREW 1 IN *Figure 1-7*		HEXAGON SOCKET COUNTERSUNK SCREW 2 IN *Figure 1-7*		HEXAGON HEAD SCREW & NUT, HEXAGON NUT WITH PLASTIC INSERT 3 IN *Figure 1-7*		SAFETY HEXAGON SOCKET HEAD SCREW 4 IN *Figure 1-7*		SAFETY HEXAGON HEAD SCREW & NUT 5 IN *Figure 1-7*		THREADED PIN 6 IN *Figure 1-7*	
Nominal thread diameter	**tightening torque Nm**	**wrench size mm**	**tightening torque Nm**	**wrench size mm**	**tightening torque Nm**	**wrench size mm**	**tightening torque Nm**	**wrench size mm**	**tightening torque Nm**	**wrench size mm**	**tightening torque Nm**	**wrench size mm**
M3	1.3	2.5	1.3	2.0	1.3	5.5`	-	-	-	-	0.8	1.5
M4	3.0	3.0	3.0	2.5	3.0	7.0	-	-	-	-	2.0	2.0
M5	6.0	4.0	6.0	3.0	6.0	8.0	10.0	4.0	9.0	8.0	3.7	2.5
M6	10.2	5.0	10.2	4.0	10.2	10.0	19.0	5.0	16.0	10.0	6.5	3.0
M8	25.3	6.0	25.3	5.0	25.3	13.0	39.0	6.0	35.0	13.0	16.0	4.0
M10	49.8	8.0	49.8	6.0	49.8	17.0	80.0	8.0	75.0	15.0	30.0	5.0
M12	87.6	10.0	87.6	8.0	87.6	19.0	120.0	10.0	115.0	17.0	-	-

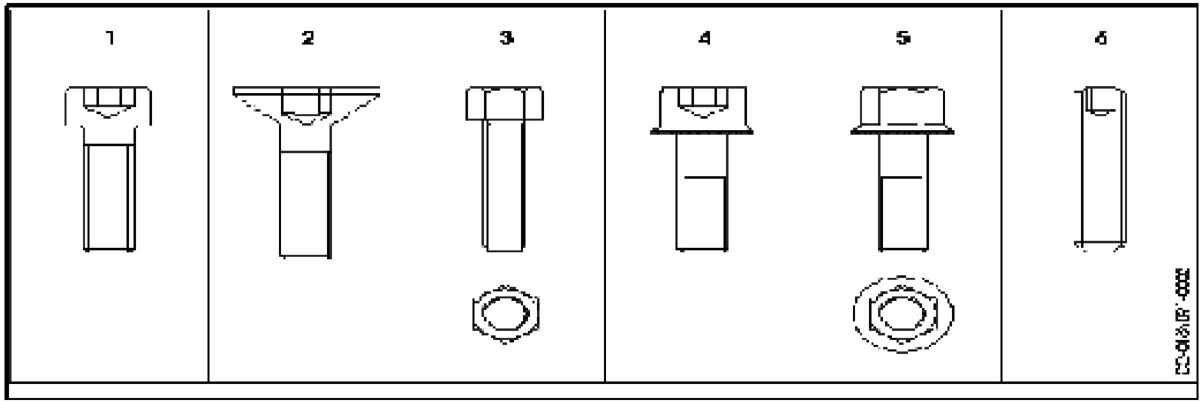


Figure 1-7: Screws Used on Mx8000 Units

Using LOCTITE

⚠ CAUTION

SCREW CONNECTIONS HAVE TO BE SECURED FOR SAFETY REASONS WITH A TORQUE WRENCH AND THE TORQUE LISTED (NM).

THE TORQUES FOR SAFETY-RELEVANT SCREW CONNECTIONS ARE LISTED IN THE ENCLOSED INSTRUCTIONS.

WHEN REPLACING SCREWS AND WASHERS ONLY IDENTICAL PARTS ARE PERMISSIBLE.

All screws and nuts on the rotating part of the Gantry must be secured with LOCTITE, except safety screws and safety nuts, which are secured in place without LOCTITE.

The following two tightness classes are used:

- LOCTITE No.222, lightly tightened and easily loosened is for all screws up to type M3, as well as all slotted screws and Phillips head screws.
- LOCTITE No. 242, moderately tightened, can still be loosened is for all screws not listed under LOCTITE No. 222.

All parts that come into contact with LOCTITE must be clean and free of grease.

Apply a few drops of LOCTITE to the screw or to the first few threads of nut threading before inserting and turning the screw or nut in place, so that LOCTITE fills the threading when the screw or nut is completely secured. Apply LOCTITE sparingly.

Since LOCTITE remains fluid on contact with air over a long time, any excess can easily be wiped away later.

NOTE:

On contact with air, LOCTITE hardens slowly. On contact with metals, it hardens only through catalyzation. Salt crystals form, which cause no damage and are non-corrosive.

Protective Measures

LOCTITE is non-toxic. However, prolonged contact with the skin can cause irritations to the skin. Wounds should be protected, since the healing process is slowed by contact with LOCTITE.

If LOCTITE splashes into the eye, rinse immediately with tap water or boric acid solution. Where contact with the skin cannot be avoided, we recommend the use of paper tissues to wipe away the LOCTITE.

After applying LOCTITE, wash hands with soap and water. Do not use a cleaning agent to clean your hands.

Storage

LOCTITE can be stored for at least once a year at room temperature. Close the bottle when not in use.

ESD (Electrostatic Discharge)

The components are delivered in pink plastic film. The film protects against dust and prevents electrostatic discharge. Some system components contain electrostatically-sensitive parts.

⚠ CAUTION

KEEP THE COMPONENTS WRAPPED IN THE PINK PLASTIC FILM UNTIL THEY ARE REQUIRED.

ALWAYS USE ESD WRISTBANDS WHEN TOUCHING ELECTRICAL COMPONENTS OR DEVICES.

ESD—Anti-Static Field Service Kit

This section describes the use of the ESD—Anti-Static Field Service Kit with the Mx8000 systems.

Purpose

This field service kit is designed to connect a field service engineer and the static-dissipative work mat to the same ground point. The wrist strap and the dissipative mat will drain any static charges from the body and from any conductive objects placed on the mat, and will prevent the generation of any new static charges.

Tools

Standard FSE tool kit

Parts

ESD—Anti-Static Field Service Kit (see *Figure 1-8*) P/N SP000335077

- Static-dissipative work mat, with pockets for storing kit components
- Ground cord assembly
  - Coiled cord
  - Black cord
  - Black snap
- Banana Plug
- Alligator clip
- Adjustable wrist strap

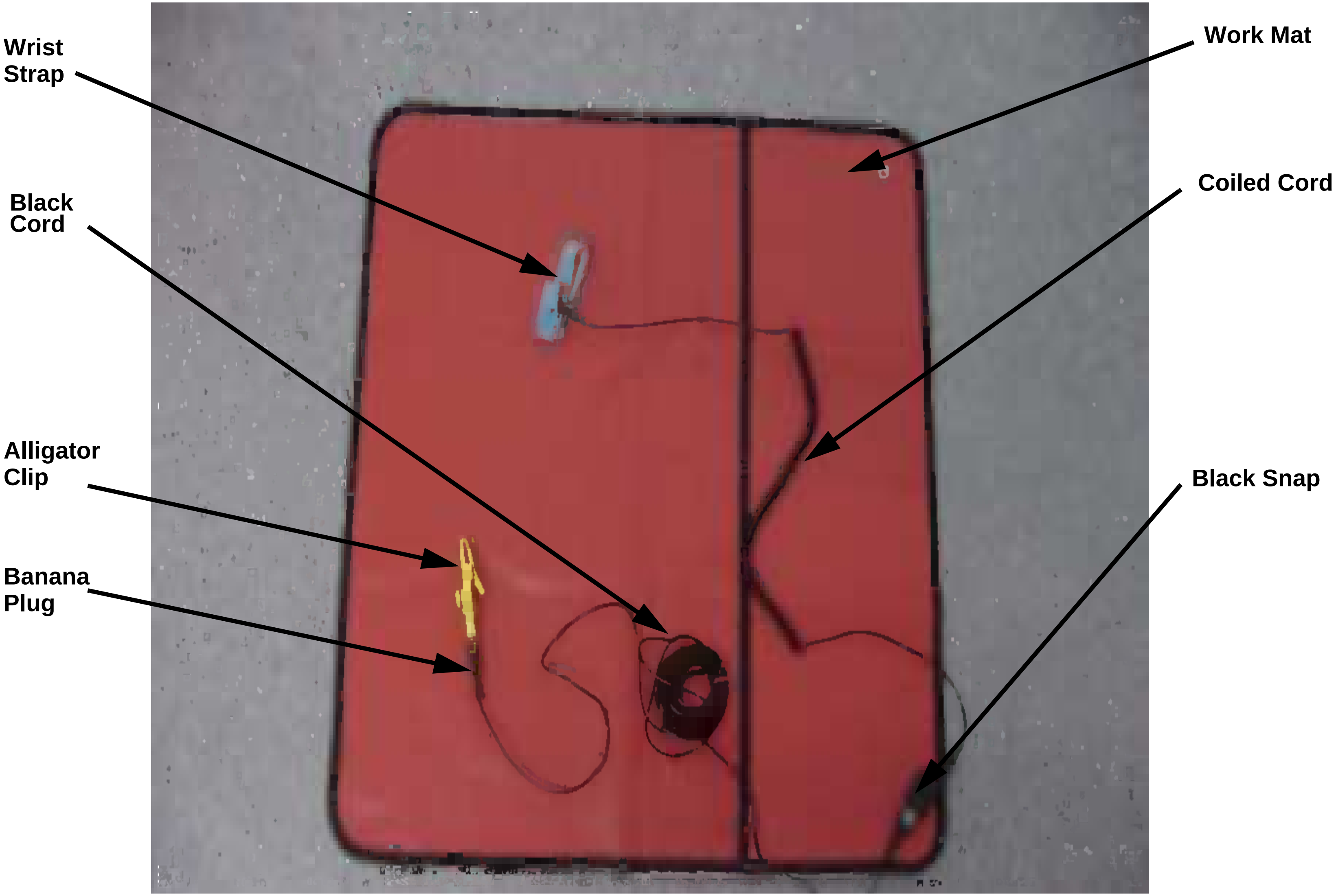

Wrist Strap
Work Mat
Black Cord
Coiled Cord
Alligator Clip
Black Snap
Banana Plug

Figure 1-8: ESD Service Kit Parts

Procedure

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE WORKING ON ELECTRICAL PARTS IN THE GANTRY ROTOR, ENSURE THAT THE GROUND CABLE IS CONNECTED TO THE STATOR AND ROTOR. TO PREVENT AN ELECTRIC SHOCK, FOLLOW THE PROCEDURE BELOW.

Connecting the Ground Cable to the Rotor and Stator

The rotor bearing is made from non-conductive material. Therefore, it is required to connect the rotor to a good ground prior to performing any service procedure on the rotor.

1. Move the couch out and down from the Gantry panel.
2. Turn the gantry power OFF, and turn the F1 switch in the PDC OFF.
3. Open the front cover, and turn the S301 to the zero position.
4. Rotate the rotor by hand until the DMS is at 12 o’clock, and lock the rotor with the locking pin.
5. Connect the ground cable to the rotor ground point and to the stator ground point (see *Figure 1-9*).

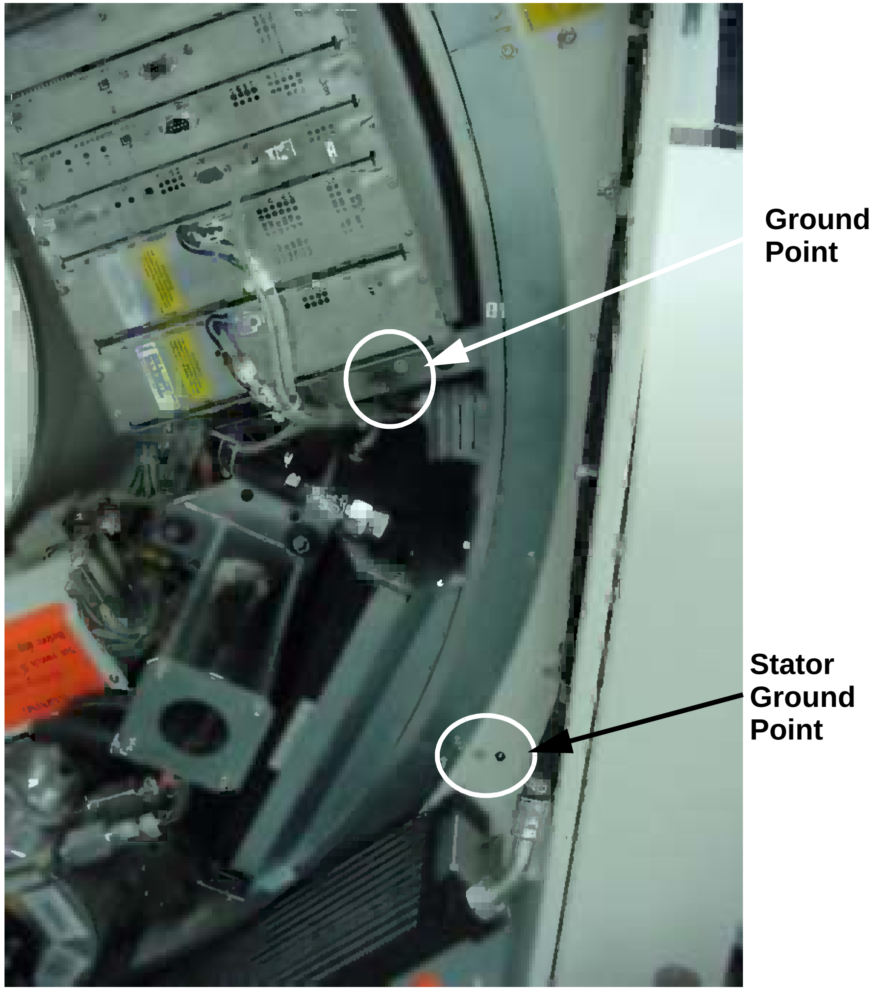

Ground
Point
Stator
Ground
Point

Figure 1-9: Ground Cable Connections

Ground Cable Connection

NOTE:

The stator contains two ground points (see *Figure 1-10*). Use one for the ground cable connection to the rotor, and the other to connect the ESD Field Service Kit.

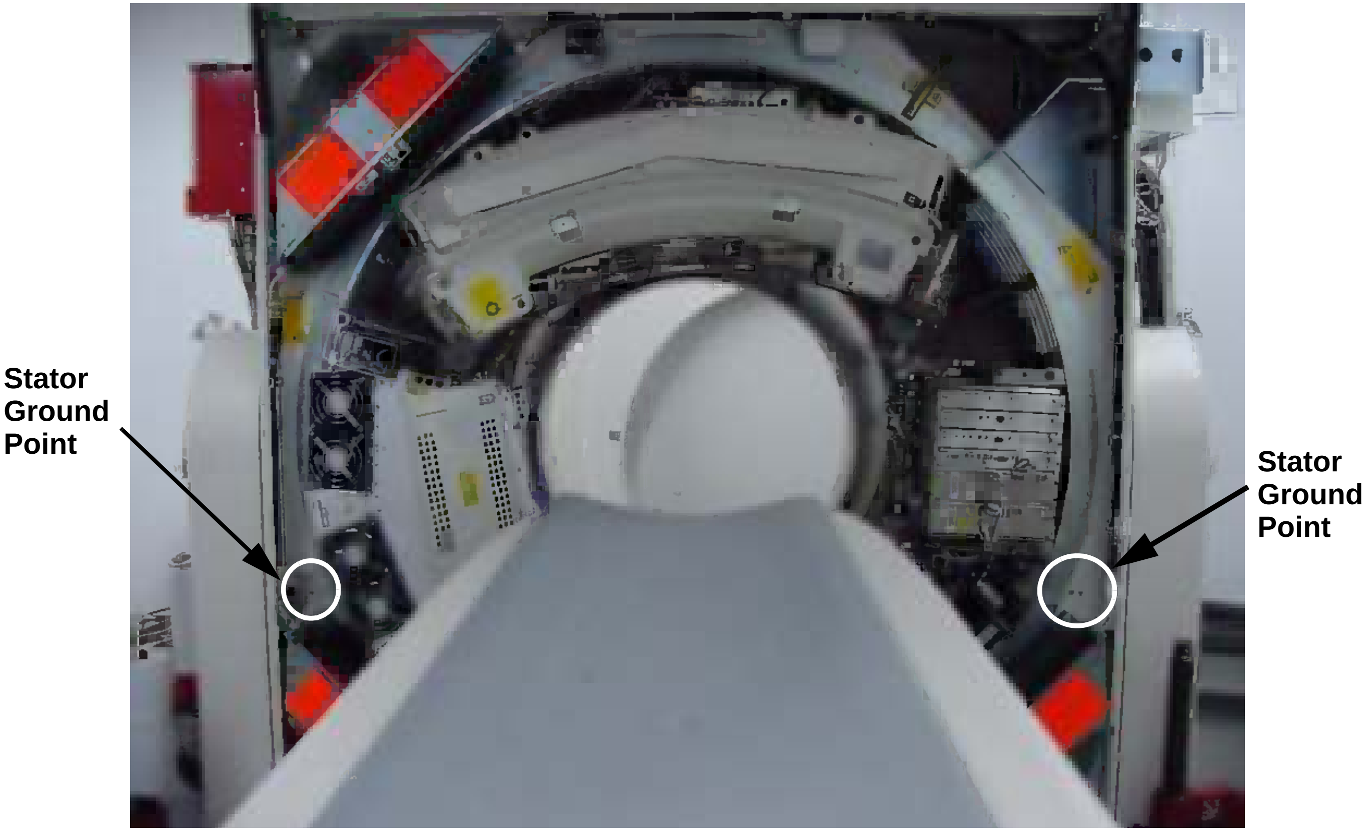


Figure 1-10: Stator Ground Points

Connecting the ESD Field Service Kit

1. Unfold the work mat on the couch and remove the kit contents from the mat pockets.
2. Snap the ground cord assembly to the work mat by means of the large black snap (see *Figure 1-11*).

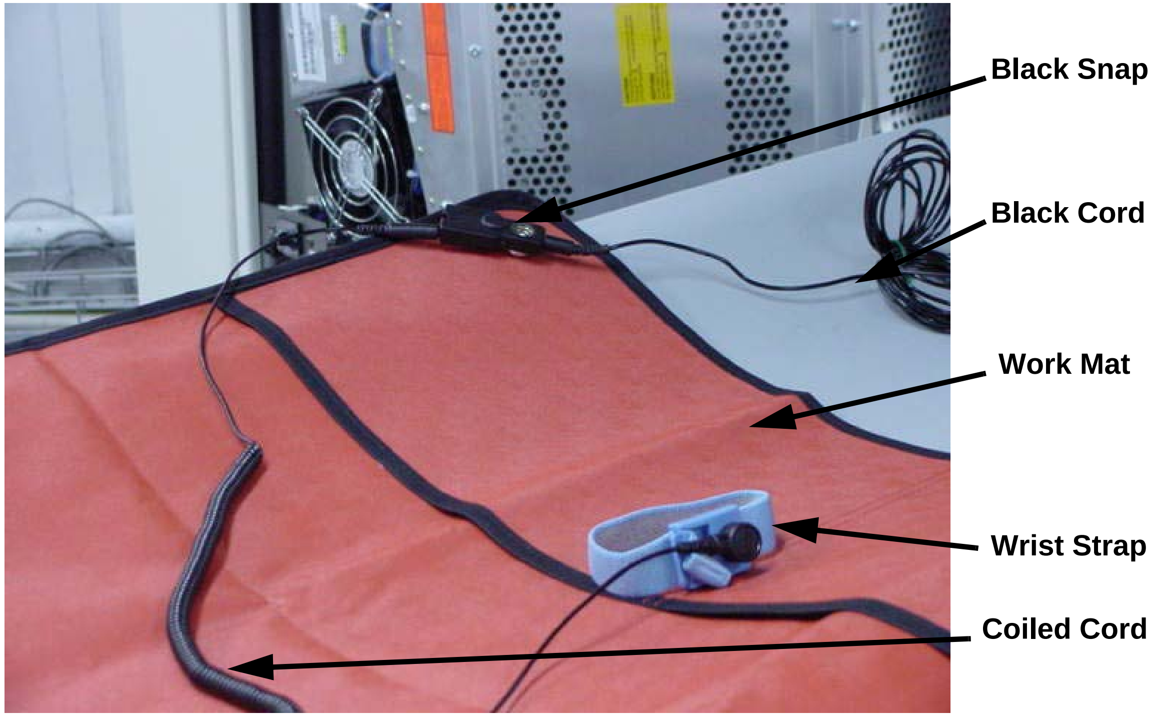


Figure 1-11: ESD Field Service Kit Components

3. Slip on the elastic wrist strap. Adjust so that the wrist strap fits snugly, yet comfortably.
4. Connect the coiled cord of the ground cord assembly to the wrist strap by means of the small plastic snap.

5. Connect the ESD to one of these units as follows:
   - Stator (when working on the DMS in the Rotor see *Step 6*)
   - Couch
   - Rack

   a. Connect the black cord of the ground cord assembly to the stator ground point by the banana plug (see *Figure 1-12*).

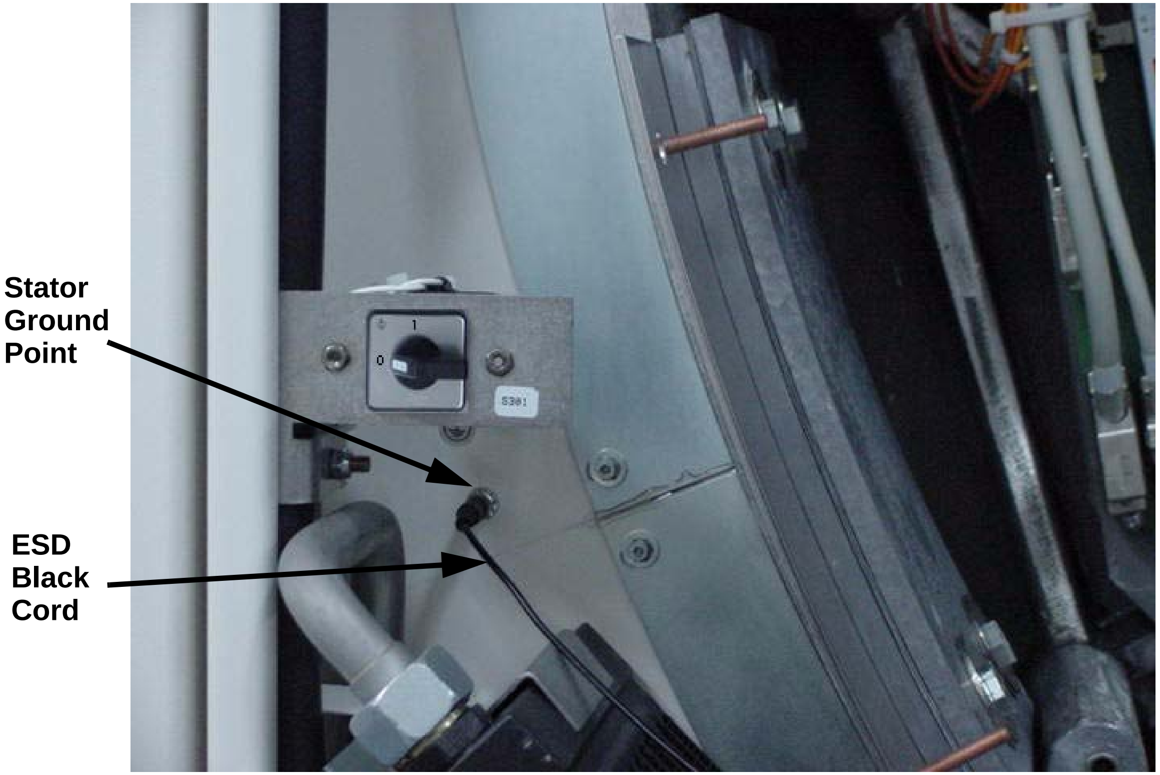


Figure 1-12: ESD Connection to the Stator

b. Connect the black cord of the ground cord assembly to a metal surface of the couch by the alligator clip (see *Figure 1-13*).

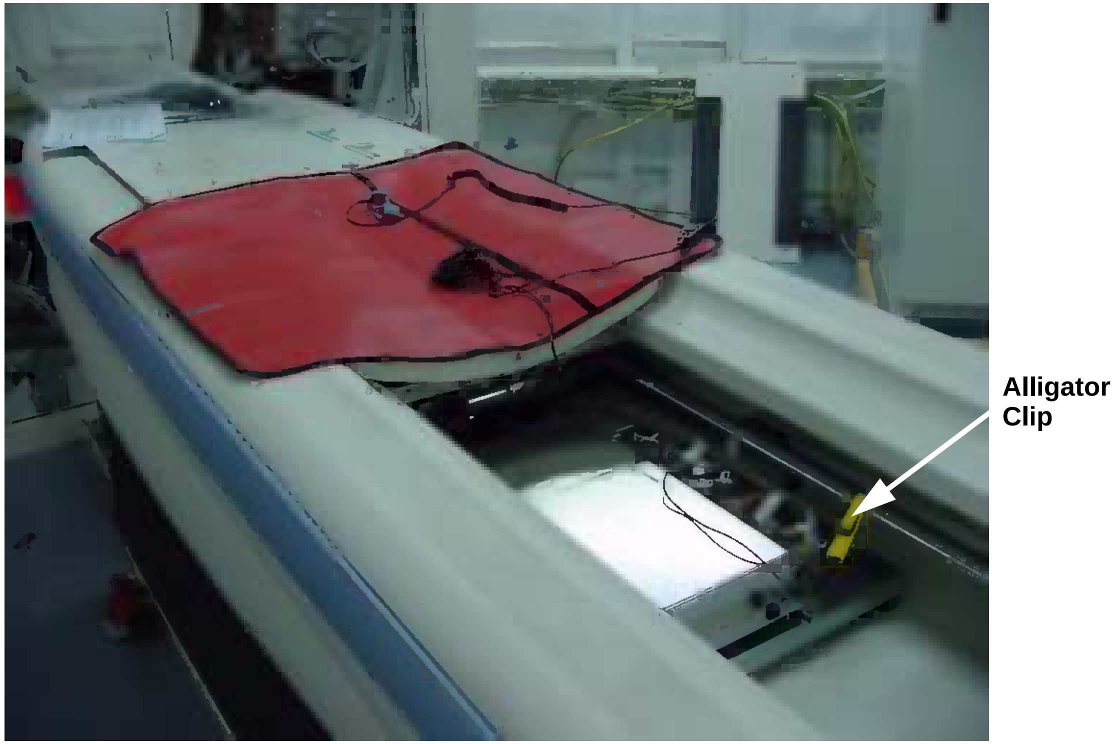


Figure 1-13: ESD Connection to the Couch

c. Connect the black cord of the ground cord assembly to a metal surface of the rack by the alligator clip (see *Figure 1-14*).

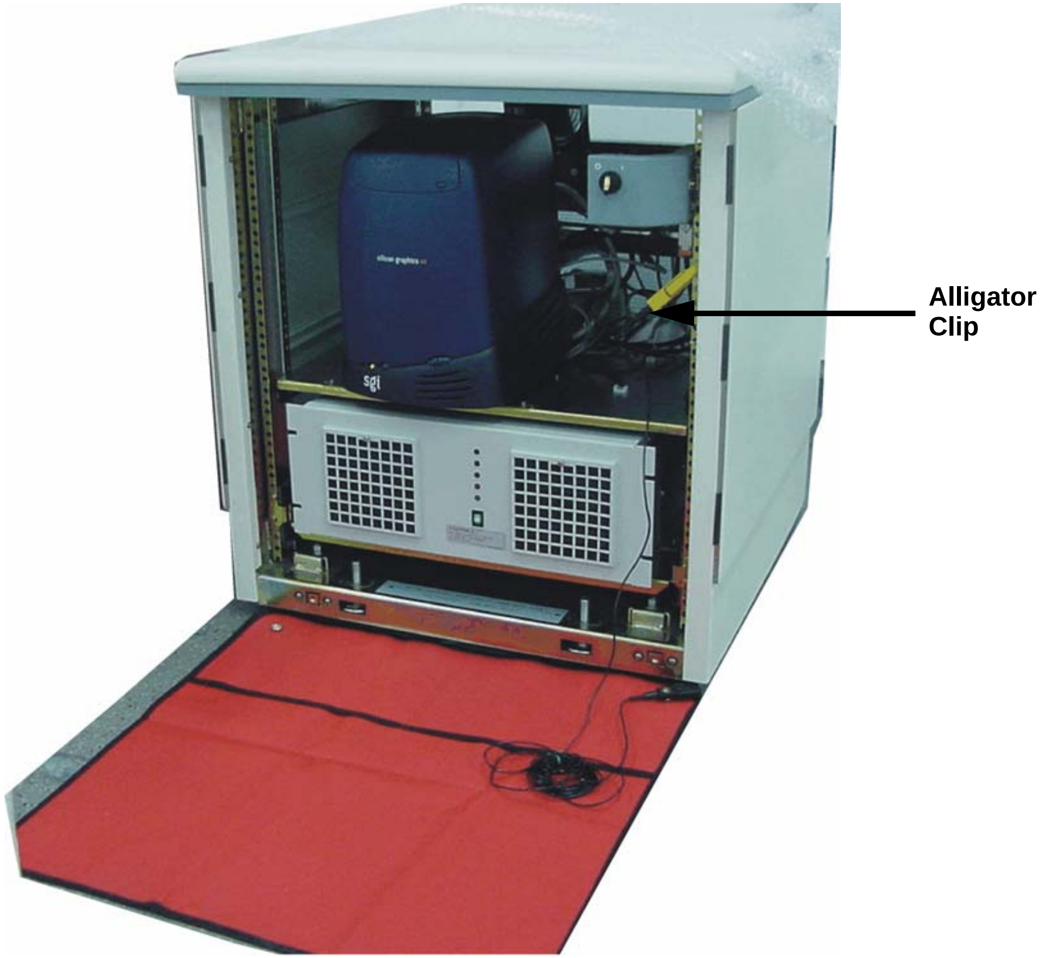


Figure 1-14: ESD Connection to the Rack

6. When working on the DMS in the Rotor, connect the ESD to the Stator.

The field service engineer is now static-protected, and can safely handle static-sensitive boards and components. Set each part on the grounded mat only.

Transport replacement PC boards in static-shielding bags or containers. Place any faulty boards removed from the equipment in static-shielding packaging so that additional damage is not done during shipment to the repair depot.

CAUTION

THE GROUNDING PROCEDURES DETAILED ABOVE EFFECTIVELY REMOVE STATIC FROM CONDUCTIVE OBJECTS LIKE THE HUMAN BODY OR METAL PARTS. HOWEVER, NONCONDUCTIVE OBJECTS (SUCH AS SYNTHETIC CLOTHING, PLASTIC COFFEE CUPS, CIGARETTE PACKS, VINYL WORK ORDER ENVELOPES, OR COMMON PLASTICS) CAN ALSO CARRY LARGE AMOUNTS OF STATIC CHARGE, AND THE CHARGES ON NONCONDUCTORS SUCH AS THESE CANNOT BE REMOVED BY GROUNDING. THEREFORE, THE ENGINEER MUST TAKE CARE TO KEEP ALL SUCH NONCONDUCTORS AS FAR FROM THE WORK AREA AND THE SENSITIVE EQUIPMENT AS POSSIBLE.

Chapter 2
Operating Station

Overview 2-1

About the Operating Station 2-1
  Operator Console 2-1
  Computer Rack 2-1

Operator Console 2-2

Monitor 2-4
Keyboard 2-4
Mouse 2-4
CT Box (Scan Control Unit) 2-5
  Gantry Control Panel 2-8
  Intercom Panel Board 2-9
  Scan Operation Board 2-16
  Encoder Board (NOT ACTIVE) 2-17

Computer Rack 2-21

The Host Computer - O2 Workstation - - - - - - - - - - - - - 2-29

Installing the Mx8000 Workstation 2-30
System First-Time Operation 2-31
Turning On The Workstation 2-31
Logging In and Out of the Workstation 2-33
The Toolchest 2-34
Checking The System Hardware Inventory 2-35
Setting System Time and Date 2-36
Turning The Workstation Off 2-37
Replacing Internal Mx8000 Modules 2-39
Replacing the System Module 2-39
Installing Memory Options (MEM-4, MEM-5, MEM-6 and MEM-7) 2-39
Checking The New Memory 2-40
Replacing the Internal Hard Disk 2-41
Replacing the Power Supply 2-41
Replacing the CD-ROM Drive 2-41
Installing External Mx8000 Peripherals 2-42
Installing the EOD Drive 2-42

IRS (Image Reconstruction System) - - - - - - - - - - - - - - 2-48

Architecture 2-48
24 SHARC Configuration - for Mx8000 Basic and Mx8000 Dual (Optional) Systems 2-50
16 SHARC Configuration - for Mx8000 Dual Systems 2-51
Parallel Backprojector Board 2-66

Diagnostics and Troubleshooting 2-78

IRS Troubleshooting 2-78
    Preface 2-78
    Safety Instructions 2-79
    Scenarios of IRS Problems 2-80
    IRS Configuration 2-82
    Scenario #1 2-83
    Scenario #2 2-89
    IRS Diagnostic Supplement 2-97
    Commands and Supplementary Data 2-120
    Diagnostic Tools and Commands 2-126
DMC Diagnostic (using Mercury Commands) 2-160
    DMC Diagnostic 2-160
    DMC Test Procedure 2-161
    DMC Sample Test Results 2-162
    Example of a DMC Test Failure 2-168
System and Expansion Card Jumper Settings 2-169
    System Card D1 (Old Revision 900-07010) 2-170
    Expansion Card D2 (Old Revision 900-07022) 2-172
    System Card D1 (New Revision) 2-173
    Expansion Card D2 (New Revision) 2-175
    PCI Link Card 2-177

Overview

About the Operating Station

The Operating Station is used to operate and monitor scans. It enables the operator to plan the patient examination procedure and execute it by activating the scanning part of the system. It acquires and stores raw data, performs real-time post-processing, and enables image reconstruction, viewing, filming and storage.

The Operating Station includes the Operator Console and the Computer Rack.

Operator Console

The operator enters commands at the console either with the keyboard or interactively with the mouse. The result is displayed on the color monitor. The scanning process is initialized from the SCAN toolbox on screen and controlled from the Scan Control Unit.

The Operator Console is a workstation for scanning and evaluation. It serves as interface between the operator and Host Computer with its software. *Figure 2-1* shows a block diagram of the Operator Console.

Computer Rack

The Computer Rack comprises two major computing and processing systems.

- Host Computer (Silicon Graphics 02)
- Image Reconstruction System (IRS)
  - ON/OFF panel with a ON switch for turning ON the computer rack.
  - OFF switch for turning OFF all the systems.

All connections between Operator's Console and the Computer Rack and Gantry run through the Signal Distribution Board (SDB). Only the Monitor, Keyboard and Mouse are connected directly to the Computer Rack (Host).

The Computer Rack is able to connect to all of the options (such as, LMI, EOD, External Floppy and Remote Control).

Operator Console

The Operator Console consists of the following:

- Color monitor
- Keyboard
- Mouse
- Scan Control Unit

The operator enters commands at the console either with the keyboard or interactively with the mouse. The result is displayed on the color monitor. The scanning process is initialized from the SCAN toolbox on screen and controlled from the Scan Control Unit.

The Operator Console is a workstation for scanning and evaluation. It serves as interface between the operator and Host Computer with its software.

The Operator Console interfaces between the Computer Rack and the operator as follows (see *Figure 2-1*):

- Command input and dialog via the keyboard
- Graphic input via a mouse
- Window modification via turnwheels
- Audio intercommunication between the patient and the operator
- Dialog and image display on the monitor

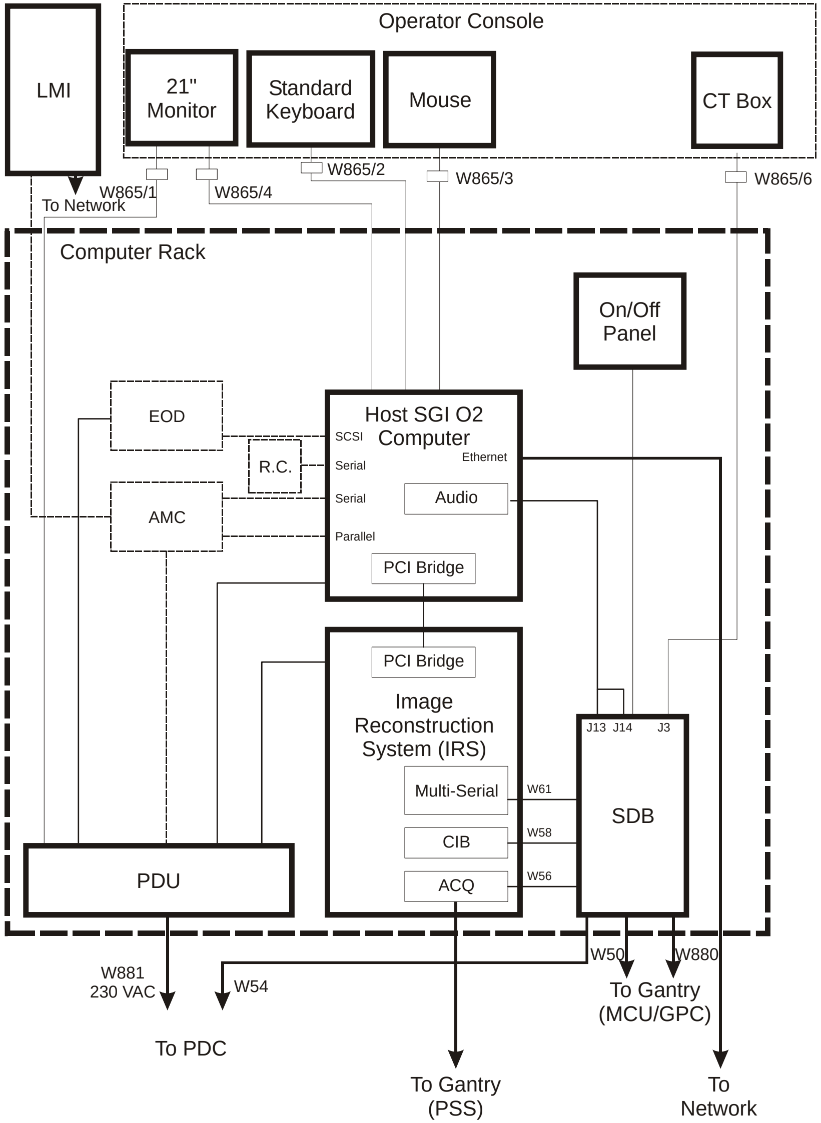

Operator Console
LMI
21" Monitor
Standard Keyboard
Mouse
CT Box
W865/1
To Network
W865/4
W865/2
W865/3
W865/6
Computer Rack
On/Off Panel
EOD
R.C.
AMC
Host SGI O2 Computer
SCSI
Serial
Serial
Parallel
Ethernet
Audio
PCI Bridge
PCI Bridge
Image Reconstruction System (IRS)
Multi-Serial
CIB
ACQ
W61
W58
W56
J13
J14
J3
SDB
PDU
W881
230 VAC
W54
To PDC
W50
W880
To Gantry (MCU/GPC)
To Gantry (PSS)
To Network

Figure 2-1: Operator Console Block Diagram

Monitor

The color monitor enables the following:

- Operator dialog with the system
- Display of medical images

Table 2-1 lists the monitor specifications.

Table 2-1: Monitor Specifications

Video Standard	High resolution and flicker-free
Screen Size	21 inch display
Screen Resolution	1280 x 1024 maximum
Deflection Frequency	Horizontal:30 to 96 kHz Vertical:48-160 kHz
Video Input	Red, Green (with SYNC) and Blue signals
Power	230 VAC supplied by the PDU (Power Distribution Unit)

Keyboard

The 02 uses a PS/2 style keyboard and mouse. These are the same type of keyboard and mouse used on the Indy and Indigo2 models.

Mouse

The mouse has three OS/2 style buttons for graphic input, to ease the command handling.

CT Box (Scan Control Unit)

The scanner is provided with a CT-Box (Scan Control Unit) that supports control of the following:

- Start scan in manual or automatic mode
- Pause scanning
- Couch in/out, up/down and gantry tilt control buttons.
- Enable automatic (computer controlled) couch and tilt motion
- Display of couch position and gantry tilt
- Console side intercom functions with volume control
- Emergency stop button
- Gantry/system ON/OFF key
- Display product and X-ray device warning indication

The CT Box controls the scan process. *Table 2-2* lists the parts of the CT Box.

Table 2-2: The Parts of the CT Box

TOOL	FUNCTION
KEYS	For scan activation and interruption
GANTRY CONTROL Buttons	Controls and displays Gantry tilt angle and table movements
X-RAY ON	Indicator Indicates that the X rays are being generated
STOP Button	Halts all Gantry and table motions and X ray generation in case of an emergency
GANTRY ON/OFF Button	Switches ON and OFF Gantry power
INTERCOM • CALL Button • TALK Button • VOLUME Button	Includes three buttons which control communications with the patient

Table 2-3: Windowing Tools - *Not Active*

TOOL	FUNCTION
• BRAIN Key • P. F. Key • BONE Key • LUNG Key • ABDOMEN Key • SPINE Key	Keys activate pre-programmed windows which display the respective organs
ALT Button	Activates the preset windows
ENHANCE Button	Sharpens or smoothes the images
CENTER and WIDTH Encoder Wheels	Finely controls the window settings

The status of the functional keys and the readings of the window control encoders are transferred to the Host Computer via two Serial Ports.

The Gantry Control Panel communicates with the GPC (Gantry Panel Control) Unit via an additional Serial Port.

The Scan Control Unit is connected to the SDB (Signal Distribution Board) by a single cable.

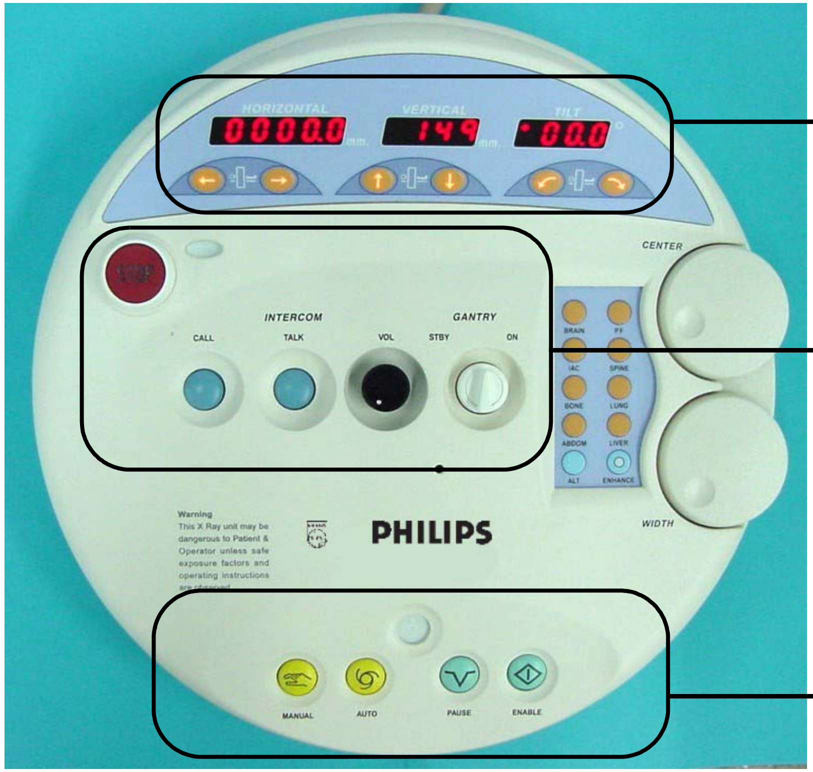

HORIZONTAL
0000.0
mm
VERTICAL
149
mm
TILT
00.0
CENTER
STOP
INTERCOM
GANTRY
CALL
TALK
VOL
STBY
ON
BRAIN
PF
IAC
SPINE
BONE
LUNG
ABDOM
LIVER
ALT
ENHANCE
WIDTH
Warning
This X Ray unit may be dangerous to Patient & Operator unless safe exposure factors and operating instructions are observed
PHILIPS
MANUAL
AUTO
PAUSE
ENABLE

Figure 2-2: CT Box

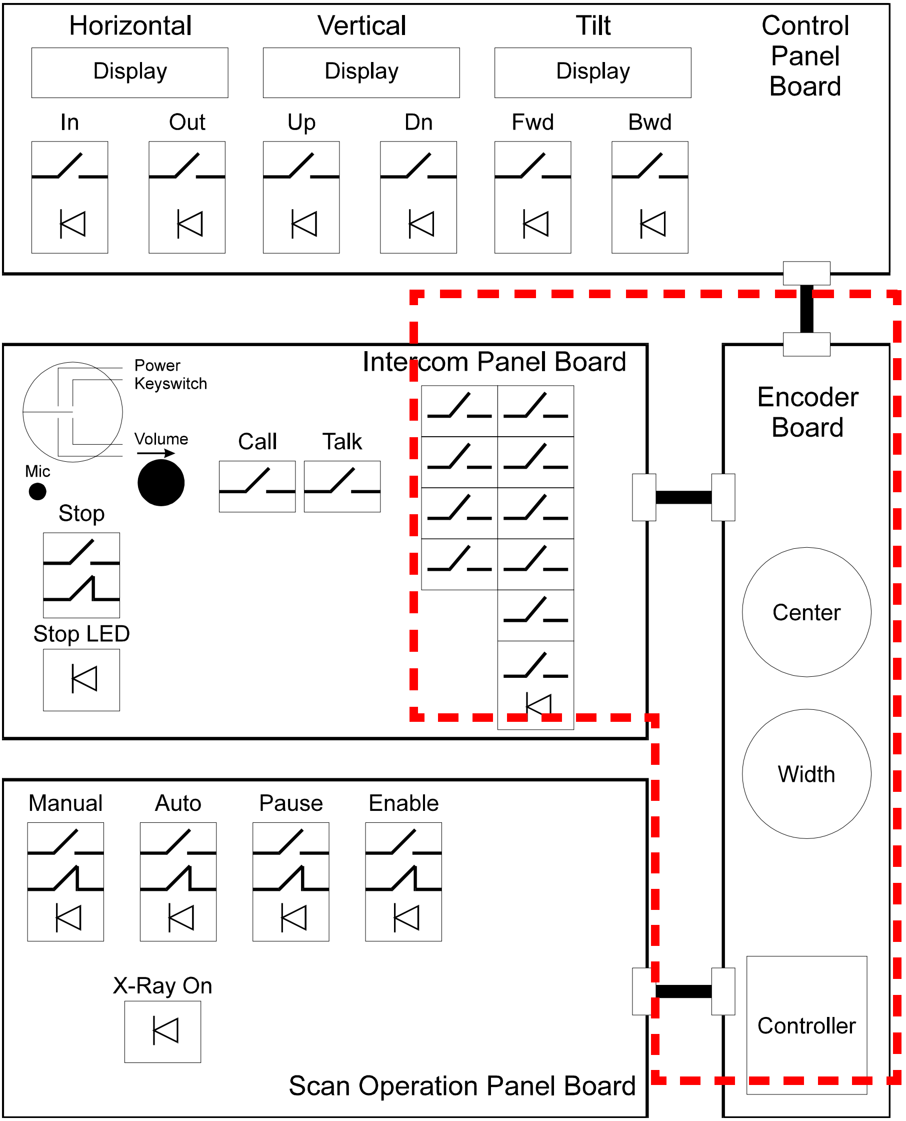

Horizontal
Display
Vertical
Display
Tilt
Display
Control Panel Board
In
Out
Up
Dn
Fwd
Bwd
Power Keyswitch
Intercom Panel Board
Volume
Mic
Call
Talk
Stop
Stop LED
Encoder Board
Center
Width
Manual
Auto
Pause
Enable
X-Ray On
Scan Operation Panel Board
Controller

Figure 2-3: CT Box Block Diagram

Gantry Control Panel

The Gantry Control Panel performs the same functions as the Gantry Panel keys.

The Panel is serially connected to the GPC through the Encoder Board.

The Gantry Control Panel consists of the following:

- Control Panel Keys

  Each key can be turned for only 4.9 seconds. Motion begins again by releasing the key and then turning it again. Each key is a single normal OPEN with a LED for:

  - — Patient Table IN
  - — Patient Table OUT
  - — Patient Table UP
  - — Patient Table DOWN
  - — Tilt FORWARD
  - — Tilt BACKWARD

- Control Panel Display

  All displays are the same as for the Gantry Display Panel.

- Voltage Supply

  12 VDC supplied from the GPC.

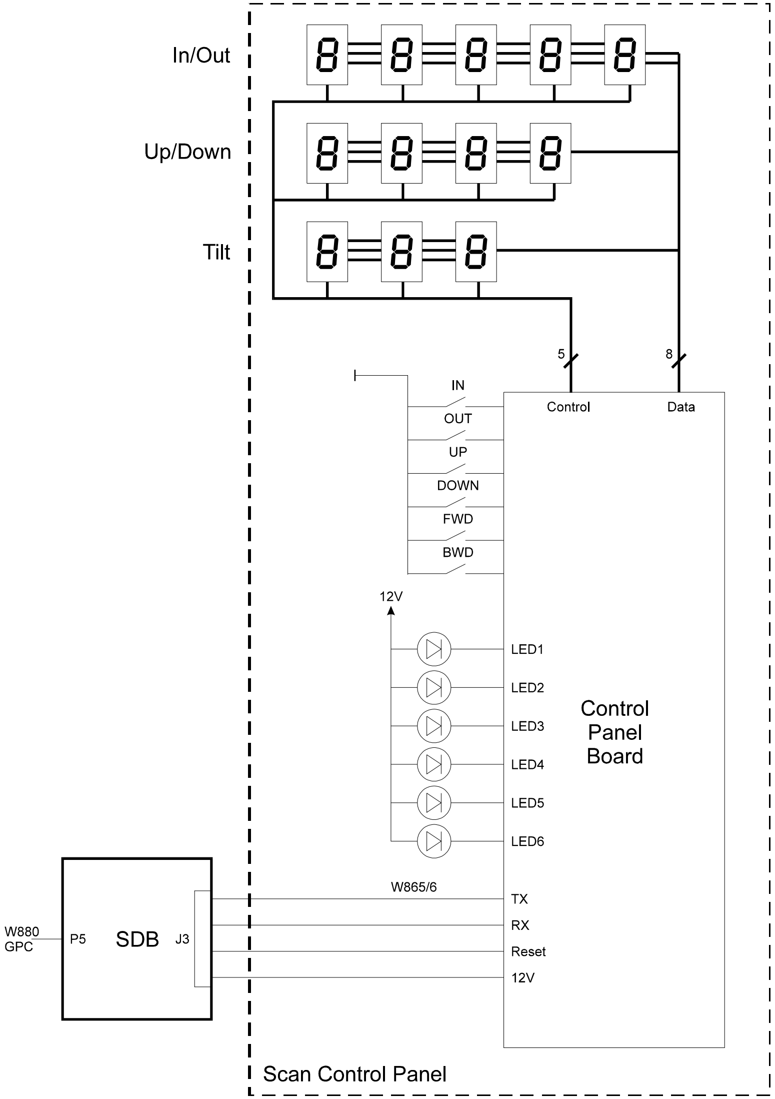

In/Out
Up/Down
Tilt
5
8
IN
OUT
UP
DOWN
FWD
BWD
Control
Data
12V
LED1
LED2
LED3
LED4
LED5
LED6
Control Panel Board
W865/6
TX
RX
Reset
12V
W880 GPC
P5
SDB
J3
Scan Control Panel

Figure 2-4: Block Diagram of the Control Panel Functions

Intercom Panel Board

The Intercom Panel Board includes several functions:

- Intercom Function
- STOP Key
- POWER Key switch
- Preset WINDOW Keys

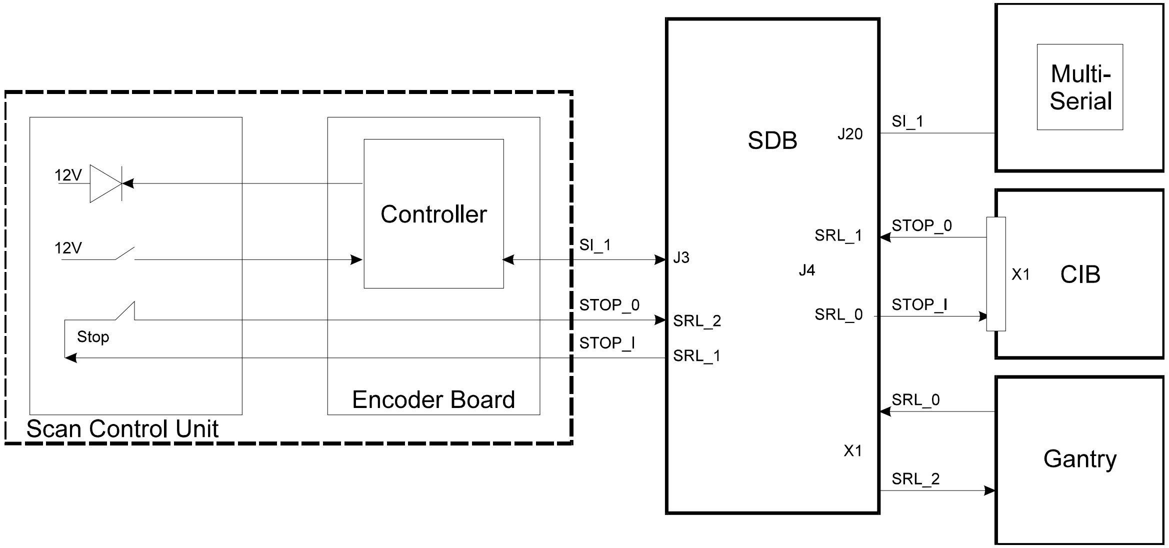

12V
12V
Stop
Controller
Encoder Board
Scan Control Unit
SI_1
STOP_0
STOP_I
J3
SRL_2
SRL_1
SDB
J20
SRL_1
J4
SRL_0
X1
SI_1
STOP_0
STOP_I
SRL_0
SRL_2
Multi-
Serial
X1
CIB
Gantry

Figure 2-5: Layout of Intercom Panel Board

Intercom Function

The Mx8000 offers an audio connection between the operator at the console and the patient in the Gantry (see*Figure 2-6*). The audio communication is controlled in one of the following ways:

- Manually, with the Scan Control Unit push buttons.
- By software, via the host speech program.

Talk to Patient

As long as the TALK button is pressed, the audio direction is from the Scan Control Unit microphone to the Gantry loudspeaker. When it is released, there is a continual monitoring line from Gantry microphones to the Scan Control Unit.

Auto Voice

Messages are transferred from the host to the patient through LINE OUT-RIGHT to the Gantry speaker located in the Gantry funnel.

Operator Instructions

Instructions to the operator are transferred from the host (to the operator) through LINE OUT-LEFT, to the Scan Control Unit speaker.

Volume

Volume controls the audio level to the Gantry to the operator.

Call

Turning the CALL key activates a two-tone doorbell sound, heard in the Gantry, through SI_1 (coming from the Host computer).

Gantry Audio

The Gantry Audio is located in the funnel and contains two boards:

- D342 includes analog amplifiers, two microphones and a loudspeaker
- D341 is a programmable board which is controlled by serial communication for reducing noise from the Gantry microphones and for controlling the output sound and loudness.

STOP Key

The Intercom Panel includes a momentary STOP button.

The STOP button has one NORMALLY-OPENED key and one NORMALLY-CLOSED key.

Stop LED

The LED illuminates as long as the system is in STOP state.

SI_1

SI_1 is the serial communication which transmits the status of the STOP key to the Host (SI_1_RXD, SI_1_TXD, SP_1_GND).

Stop Report Loop, STOP_0, STOP_I

STOP_0 and STOP_I signals open the Stop Report Loop.

Power

12 VDC are supplied to the Scan Control Unit from the CIB board:

- 12 V-CIB-12 VDC
- GND-CIB-GND

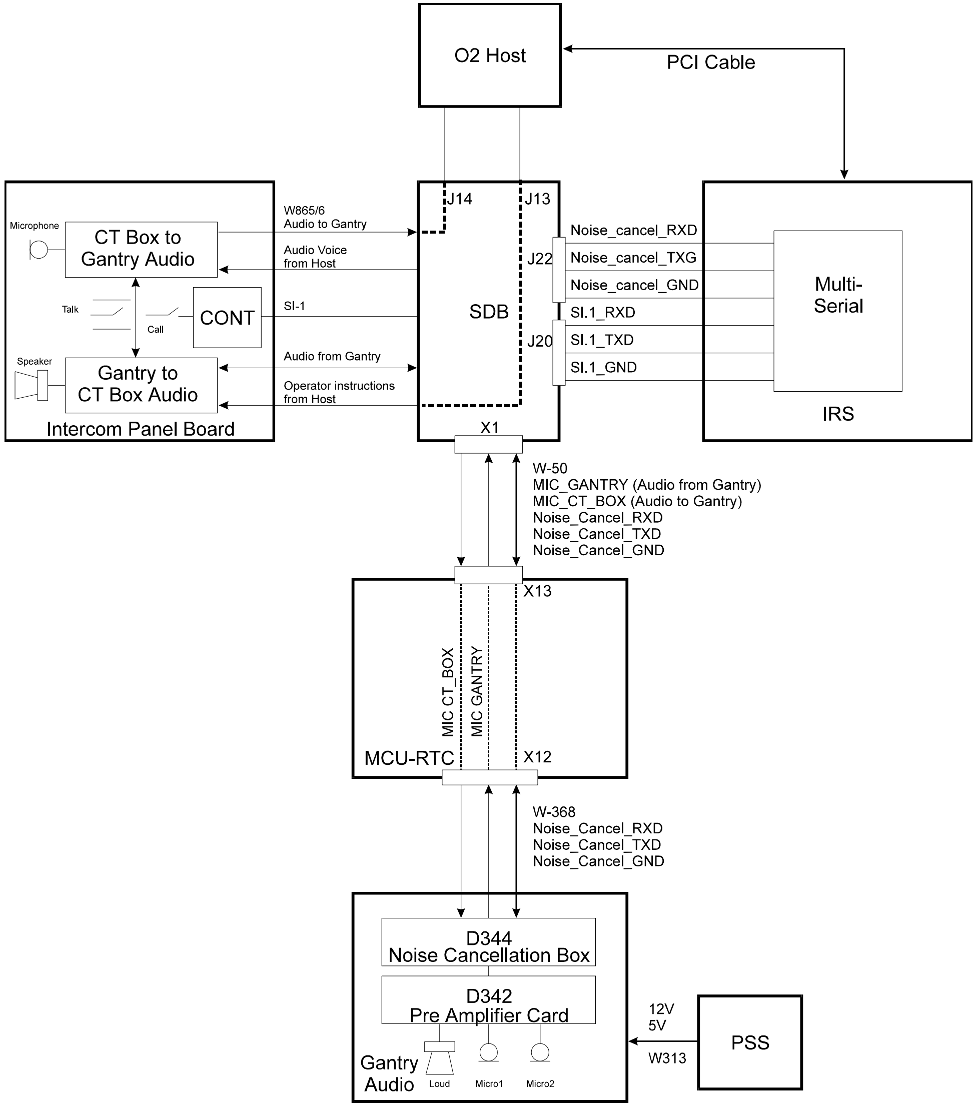

O2 Host
PCI Cable
Microphone
CT Box to
Gantry Audio
Talk
Call
CONT
Speaker
Gantry to
CT Box Audio
Intercom Panel Board
W865/6
Audio to Gantry
Audio Voice
from Host
SI-1
Audio from Gantry
Operator instructions
from Host
J14
J13
SDB
J22
J20
X1
Noise_cancel_RXD
Noise_cancel_TXG
Noise_cancel_GND
SI.1_RXD
SI.1_TXD
SI.1_GND
Multi-
Serial
IRS
W-50
MIC_GANTRY (Audio from Gantry)
MIC_CT_BOX (Audio to Gantry)
Noise_Cancel_RXD
Noise_Cancel_TXD
Noise_Cancel_GND
X13
MIC CT_BOX
MIC GANTRY
MCU-RTC
X12
W-368
Noise_Cancel_RXD
Noise_Cancel_TXD
Noise_Cancel_GND
D344
Noise Cancellation Box
D342
Pre Amplifier Card
Gantry
Audio
Loud
Micro1
Micro2
12V
5V
W313
PSS

Figure 2-6: Block Diagram of the Audio Controls and Intercom

POWER Key Switch

The Mx8000 is operated in Computer ON mode with the key turned to the Gantry OFF position or in Scan mode by turning the key to Gantry ON (see *Figure 2-7*).

System ON (Gantry ON)

Turning the key to this position turns ON the entire system with all its components. It is then ready for patient examination.

Gantry ON Position

The Gantry ON Position activates relay K2 in the PDS and enables full power supply for all components. It also sends a status signal through SI_1 serial line to the Host.

Computer ON (Gantry OFF)

The Computer ON (Gantry OFF) mode activates only the Operating Station components by turning the Gantry OFF switch. Scanning is not possible in this mode.

Gantry OFF Position

The Gantry OFF Position activates relay K1 in the PDS and enables a partial power supply. Status from the key is read through SI_1 serial line to the Host. The operating station is ON in this mode.

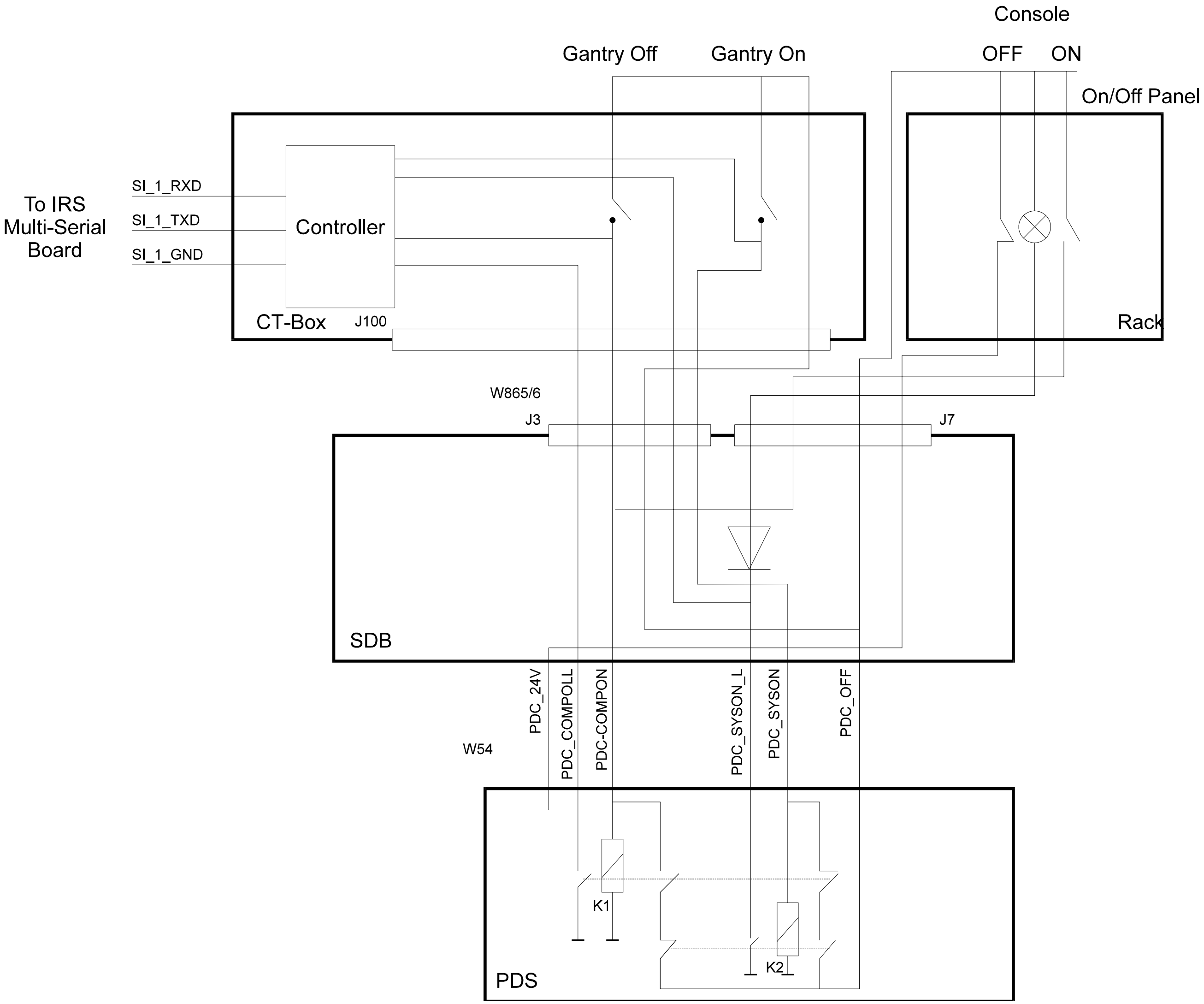

Console
Gantry Off
Gantry On
OFF
ON
On/Off Panel
To IRS
Multi-Serial
Board
SI_1_RXD
SI_1_TXD
SI_1_GND
Controller
CT-Box
J100
Rack
W865/6
J3
J7
SDB
PDC_24V
PDC_COMPOLL
PDC-COMPON
PDC_SYSON_L
PDC_SYSON
PDC_OFF
W54
K1
K2
PDS

Figure 2-7: Gantry ON and OFF Boards

Pre-Set WINDOW Keys (NOT ACTIVE)

The Intercom Panel includes ten NORMALLY-OPENED momentary keys. The keys are connected to the Encoder Board Controller.

WINDOW Keys

The BRAIN, P. F., BONE, LUNG, ABDOMEN and SPINE keys activate pre-programmed windows to display the respective organs. The following are the ten preset WINDOW keys:

1. BRAIN
2. P. F.
3. IAC
4. SPINE
5. BONE
6. LUNG
7. ABDOMEN
8. LIVER
9. ALT
10. ENHANCE

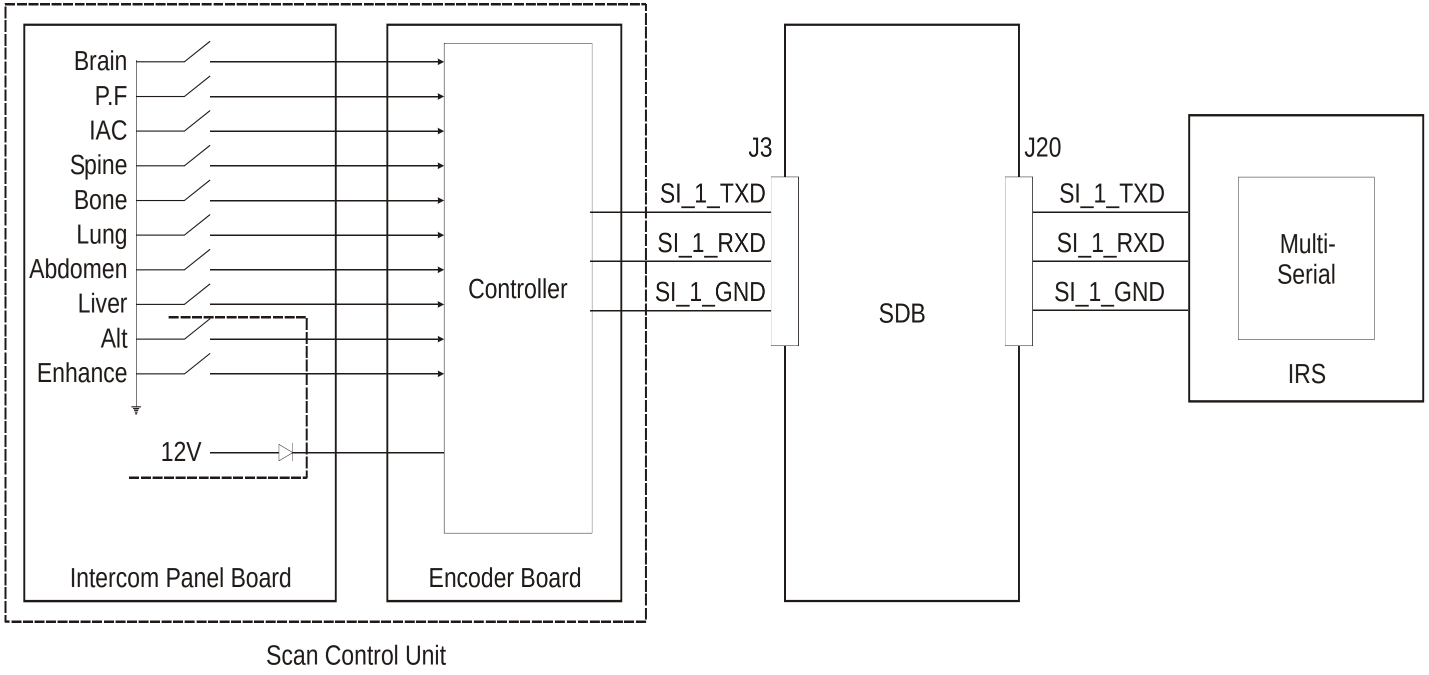

Brain
P.F
IAC
Spine
Bone
Lung
Abdomen
Liver
Alt
Enhance
12V
Intercom Panel Board
Controller
Encoder Board
Scan Control Unit
J3
SI_1_TXD
SI_1_RXD
SI_1_GND
SDB
J20
SI_1_TXD
SI_1_RXD
SI_1_GND
Multi-
Serial
IRS

Figure 2-8: Layout of Window Keys

ENHANCE Key

The ENHANCE Key sharpens or smooths the images. This key has its own LED.

Scan Operation Board

The Scan Operation Board includes Function Keys, LED keys and an X-ray ON LED.

Function Keys

The following Function Keys control the scan:

MANUAL SCAN

The MANUAL light on the SCAN PANEL lights up indicating that the scanner is ready to perform a single scan.

AUTO SCAN

The AUTO SCAN Button performs a series of scans without operator intervention.

PAUSE

The PAUSE/STOP Button interrupts the scanning series.

ENABLE

The ENABLE Button enables automatic Table and Gantry movements, e.g., after Plan on Surview when the Table and Gantry move to the planned position and tilt.

Each key has the following two positions:

1. The first position controls hardware (a requirement for the safety of the system). This line goes to the MCU.
2. The second position controls the software and it goes to the Host through SI_1 serial line. The MANUAL and AUTO keys generate the same hardware signal (START).

LED Keys

Each one of the keys includes LEDs which light up, via the Controller, when the applicable function is active.

X-ray ON LED

The X-ray ON LED displays the X-ray ON condition and it lights up during X-ray ON. X-ray ON also signals to the ACQ card for X-ray ON.

Encoder Board (NOT ACTIVE)

The Encoder Board includes several functions (see *Figure 2-9*):

- Center and Width Encoders
- Scan Control Unit Controller
- Connections to/from the other Scan Control Unit boards

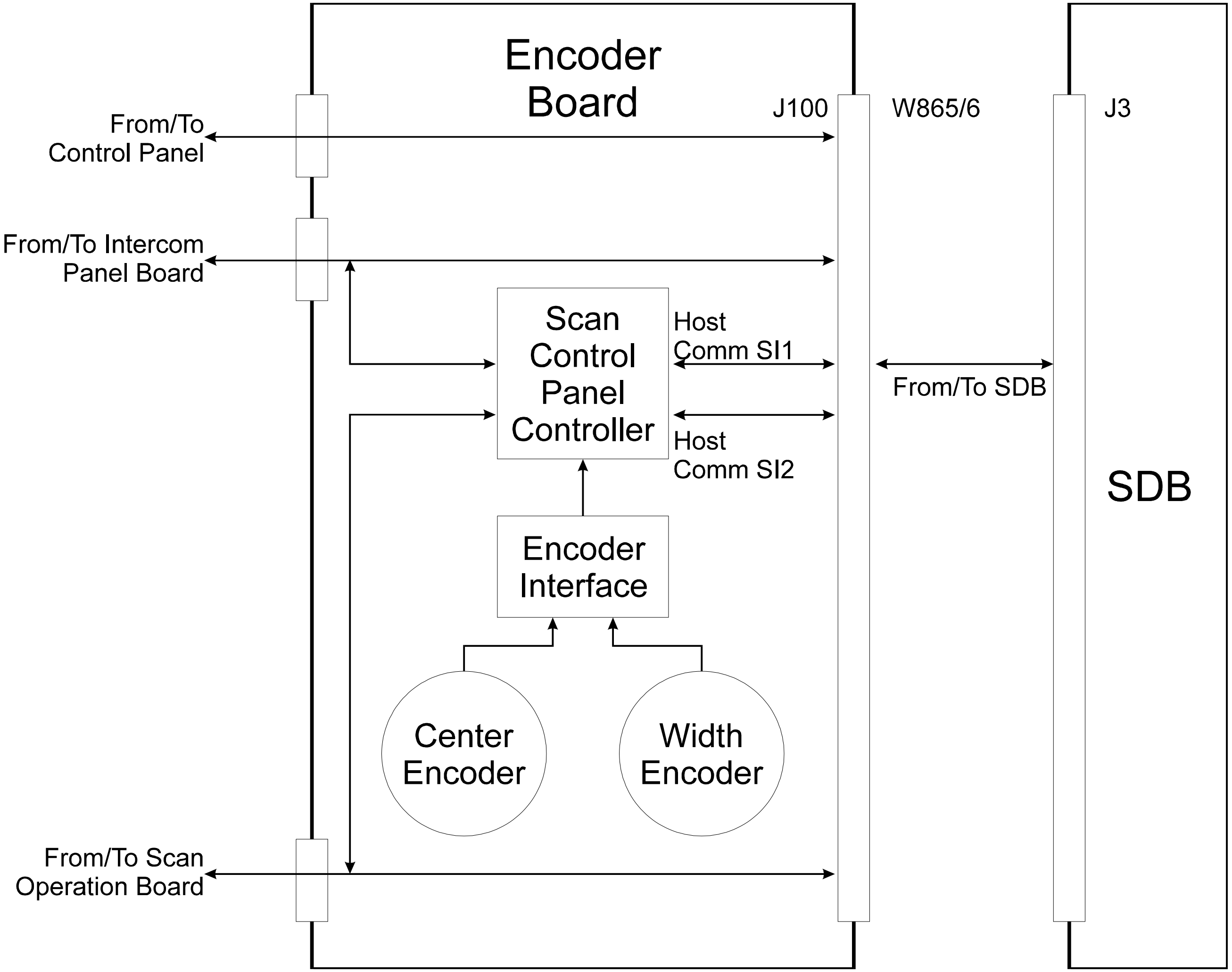

Encoder Board
J100
W865/6
J3
From/To Control Panel
From/To Intercom Panel Board
Scan Control Panel Controller
Host Comm SI1
Host Comm SI2
From/To SDB
SDB
Encoder Interface
Center Encoder
Width Encoder
From/To Scan Operation Board

Figure 2-9: Encoder Board Block Diagram - NOT ACTIVE

Center and Width Encoders (NOT ACTIVE)

The Windowing function includes two optical encoder wheels, CENTER and WIDTH, for fine control of the window settings.

A dedicated serial communication line-SI_2 will transmit the encoder readings (movement) to the Host.

At least eight readings per second are required when an encoder is moving.

Scan Control Unit Controller

The Scan Control Unit Controller is a microcontroller that handles all the Scan Control Unit functions. The Controller has two serial communication interfaces to the Host; one for the optical encoders and the other for all the other Scan Control Unit devices.

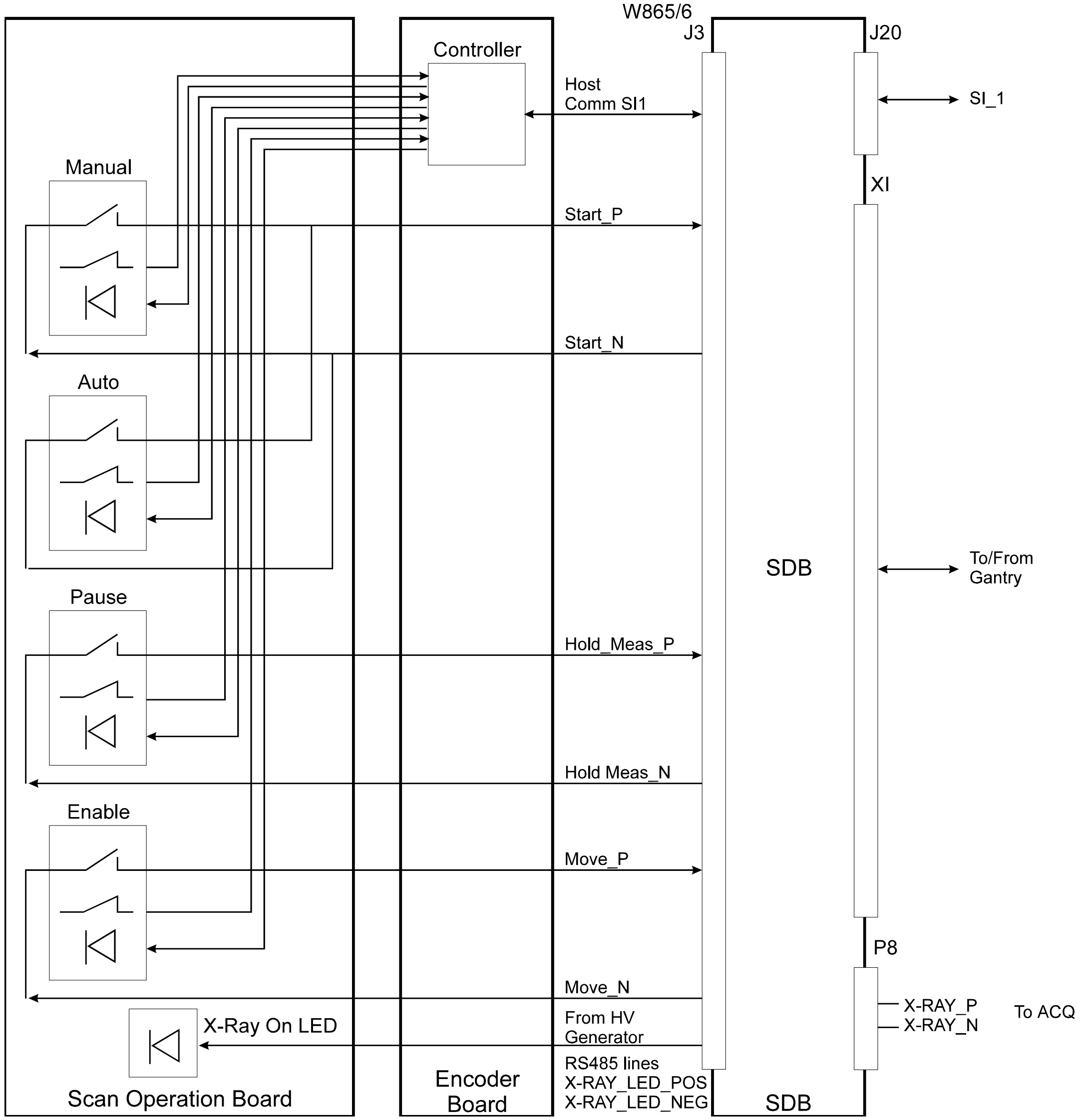

W865/6
J3
J20
Controller
Host
Comm SI1
SI_1
XI
Manual
Start_P
Start_N
Auto
SDB
To/From
Gantry
Pause
Hold_Meas_P
Hold Meas_N
Enable
Move_P
P8
Move_N
X-RAY_P
X-RAY_N
To ACQ
X-Ray On LED
From HV
Generator
RS485 lines
X-RAY_LED_POS
X-RAY_LED_NEG
Encoder
Board
Scan Operation Board
SDB

Figure 2-10: Scan Operation Board Diagram

Computer Rack

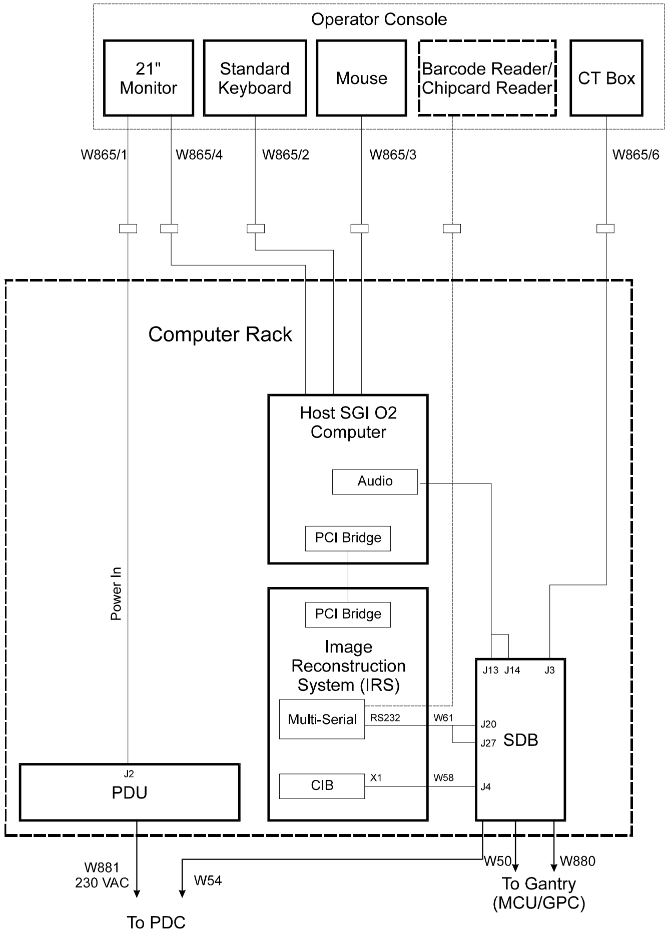
The Computer Rack includes the following interfaces:

- AC power input from PDC
- UPS Interface
- Optical fiber link with the DMS
- Serial communication and control lines to/from MCU
- Can bus communication with the Gantry
- Audio signal lines with the Gantry
- Stop Report chain
- Network interface
- Teleservice communication

An ON/OFF switch turns OFF the Computer Rack and Gantry systems.

The ON switch supplies power only to the Computer Rack. The O2 Computer must be switched ON separately.

The Power Distribution Unit (PDU) receives power 230 VAC voltage from the Power Distribution Cabinet (PDC) and distributes the voltage to all the components of the Operator's station (see *Figure 2-11*).



Operator Console
21" Monitor
Standard Keyboard
Mouse
Barcode Reader/ Chipcard Reader
CT Box
W865/1
W865/4
W865/2
W865/3
W865/6
Computer Rack
Host SGI O2 Computer
Audio
PCI Bridge
Power In
PCI Bridge
Image Reconstruction System (IRS)
Multi-Serial
RS232
W61
CIB
X1
W58
J13 J14 J3
J20
J27
SDB
J4
J2
PDU
W881 230 VAC
W54
To PDC
W50
W880
To Gantry (MCU/GPC)

Figure 2-11: Computer Rack Block Diagram

The Computer Rack consists of two major computing and processing systems (see *Figure 2-12*):

- Host Computer
- Image Reconstruction System (IRS)

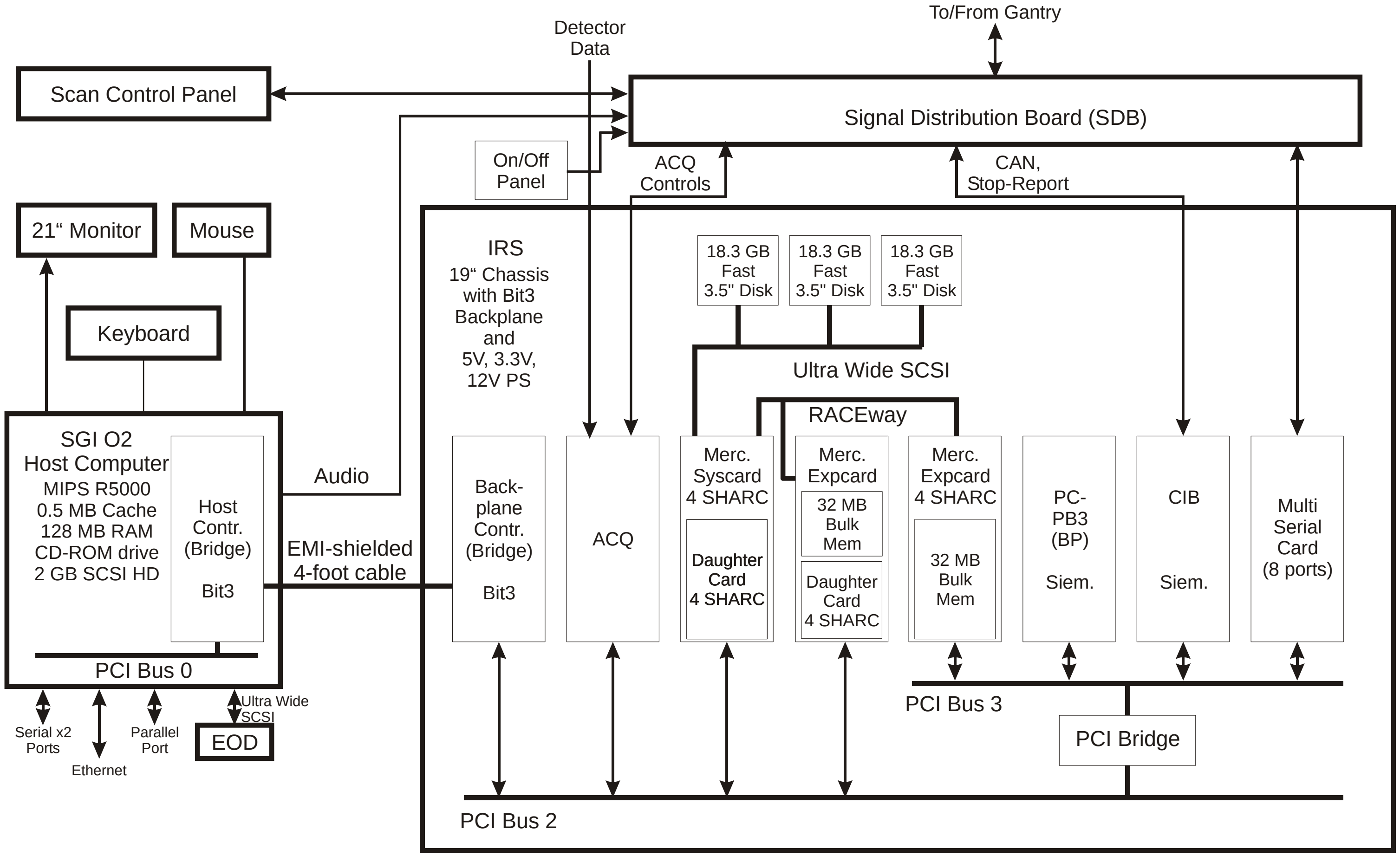

Detector Data
To/From Gantry
Scan Control Panel
Signal Distribution Board (SDB)
On/Off Panel
ACQ Controls
CAN, Stop-Report
21“ Monitor
Mouse
Keyboard
IRS
19“ Chassis with Bit3 Backplane and 5V, 3.3V, 12V PS
18.3 GB Fast 3.5" Disk
18.3 GB Fast 3.5" Disk
18.3 GB Fast 3.5" Disk
Ultra Wide SCSI
RACEway
SGI O2 Host Computer
MIPS R5000
0.5 MB Cache
128 MB RAM
CD-ROM drive
2 GB SCSI HD
Host Contr. (Bridge)
Bit3
Audio
EMI-shielded 4-foot cable
Back-plane Contr. (Bridge)
Bit3
ACQ
Merc. Syscard 4 SHARC
Daughter Card 4 SHARC
Merc. Expcard
32 MB Bulk Mem
Daughter Card 4 SHARC
Merc. Expcard 4 SHARC
32 MB Bulk Mem
PC-PB3 (BP)
Siem.
CIB
Siem.
Multi Serial Card (8 ports)
PCI Bus 0
Serial x2 Ports
Ethernet
Parallel Port
Ultra Wide SCSI
EOD
PCI Bus 3
PCI Bridge
PCI Bus 2

Figure 2-12: Computer Rack Host-IRS Block Diagram

Power

The Computer Rack receives AC Power to the PDU from the PDC (230 VAC) (see *Figure 2-13*).

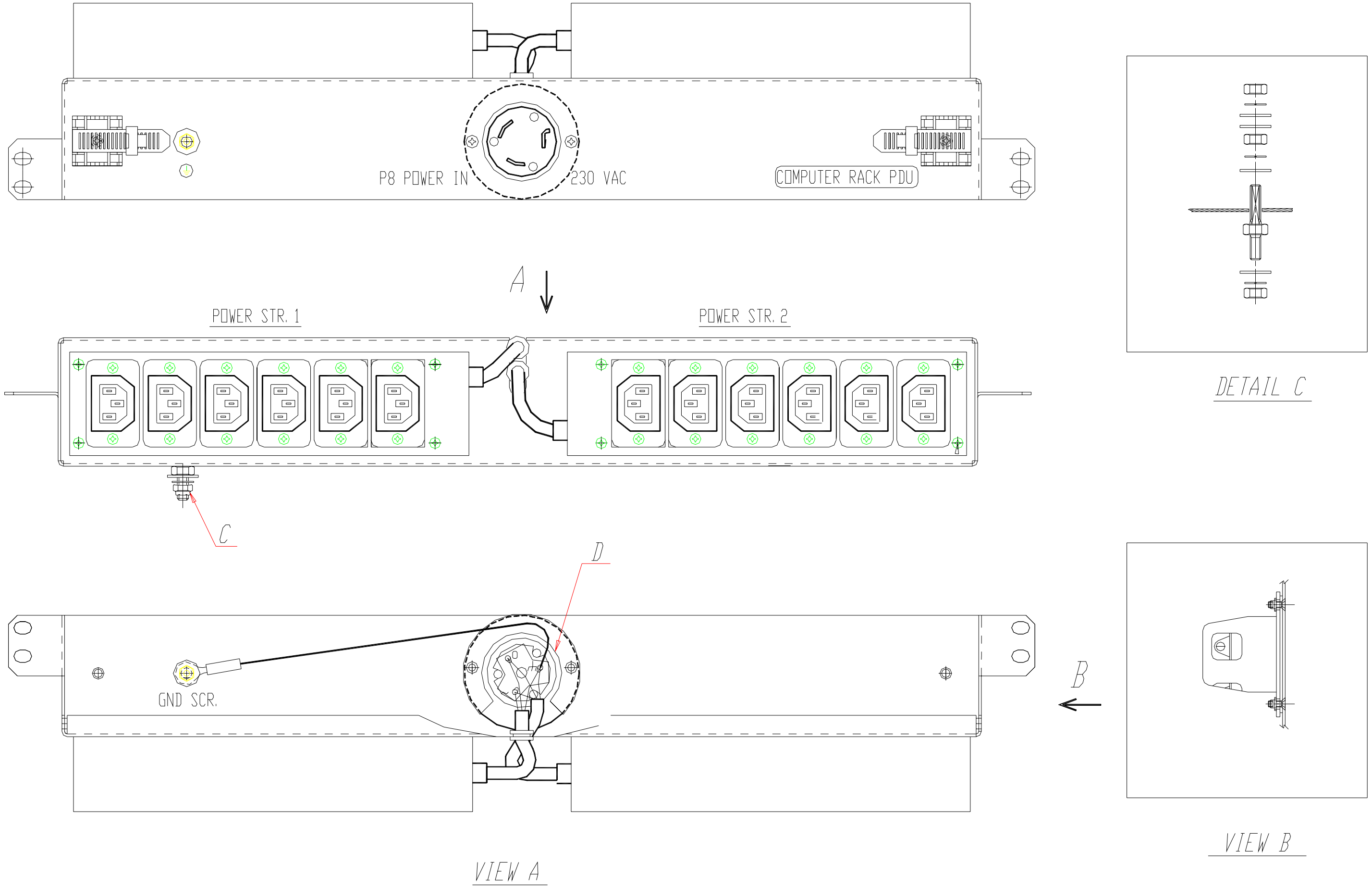

P8 POWER IN
230 VAC
COMPUTER RACK PDU
A
POWER STR. 1
POWER STR. 2
C
D
GND SCR.
B
VIEW A
DETAIL C
VIEW B

Figure 2-13: PDU Panel Assembly

AMC-4

Laser Multi-imager Interface provides the connectivity between the O2 and the Laser Multi-imager. The AMC is connected to the O2 through the parallel and Serial Ports. *Table 2-1* specifies the cables in use. The cable numbers correspond to the numbers in *Figure 2-14*.

Table 2-1: Cables in Use

CABLE #	CABLE NAME	LENGTH
1[1]	Host Parallel Cable	2.1 m/82.6 in.
2[1]	Host Serial Cable	2.1 m/82.6 in.
3[2]	F. S. in 3M Cable F. S. in Kodak Cable F. S. in Dupont/AGFA Cable	0.3 m/11.8 in. 0.3 m/11.8 in. 0.3 m/11.8 in.
4[2]	F. S. in 3M Cable F. S. in Kodak Cable F. S. in Dupont/AGFA Cable	3.0 m/118.1 in. 2.5 m/98.4 in. 2.5 m/98.4 in.
5	LMI Parallel Cable	16.0 m/52.49 ft
6[3]	Power Cable (110 V, U. S. Standard) Power Cable (220 V, IEC 320 Standard)	2.3 m/90.5 in. 3.0 m/118.1 in.
7[4]	Printer Cable	-
8[5]	LMI 952 Serial Cable	16.0 m/52.49 ft

1. USE CABLES COMPATIBLE WITH THE O2 COMPUTER.
2. CABLES ARE SUPPLIED FOR VARIOUS IMAGERS, INCLUDING 3M, KODAK, DUPONT AND AGFA.
3. USE A CABLE COMPATIBLE WITH YOUR LOCAL POWER REGULATIONS.
4. CABLE 7 IS NOT SUPPLIED. (USE THE CABLE SUPPLIED WITH THE PRINTER.)
5. USED ONLY WITH THE 3M 952 OR 3M 959 LMI.

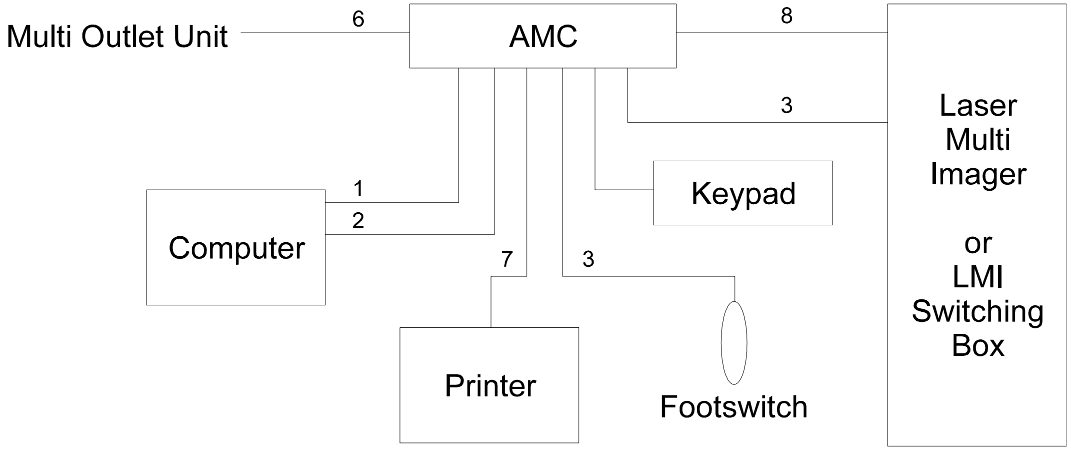


Figure 2-14: AMC Cabling Diagram

LEDs

The AMC features four LED indicators for reporting status and activity. The Xfer LED is located on the front panel while the other three are located on the rear panel. The following table describes the LEDs display of functions, according to their conditions.

Table 2-2:

LED	DISPLAY AND FUNCTION
Xfer	ON-The AMC is in image transfer mode OFF-The AMC is in idle mode
PWR	ON-Power switch ON, power applied to AMC OFF-Power switch OFF or no power applied to AMC
TX	BLINK-Data is sent to the LMI OFF-No data is sent to the LMI
RX	BLINK-Data is received from the workstation OFF-No data is received from the workstation

Cisco 10/100 Switch

The purpose of the Cisco 10/100 Switch is to improve image transfer performance from the Mx8000 to the MxView workstation, to PACS, or to any other workstation on the local network.

Technical Advantage

The Cisco 10/100 Switch is an advanced communications unit with capabilities that surpass the performance of the standard hub. The switch transfer rate is autosense 10 or 100 Mbit/sec.

Up to 12 units can be connected to the Cisco 10/100 Switch in any order.

Connection

The Cisco 10/100 Switch can be connected to additional stations where transferral of images is needed.

The Cisco 10/100 Switch replaces the hub supplied with the MxView and should not be used in conjunction with the hub.

Use CAT5 (100 BaseT) cables for connection to the Cisco 10/100 Switch.

The maximum length of CAT5 (100 BaseT) cable is 60 meters.

For additional information and support, contact the hospital system administrator.

NOTE:

The Cisco 10/100 Switch has additional properties that we are not interested in using and are not necessary for our purpose. Do not define it for use with other applications as this can interfere with the purpose detailed in this document.

Signal Distribution Board (SDB)

The Signal Distribution Board (SDB) is the interface between the Computer Rack of the Operator Console and the Gantry. The SDB includes all the connectors which distribute the signals to the system. The board is passive; it does not include an electronic circuit.

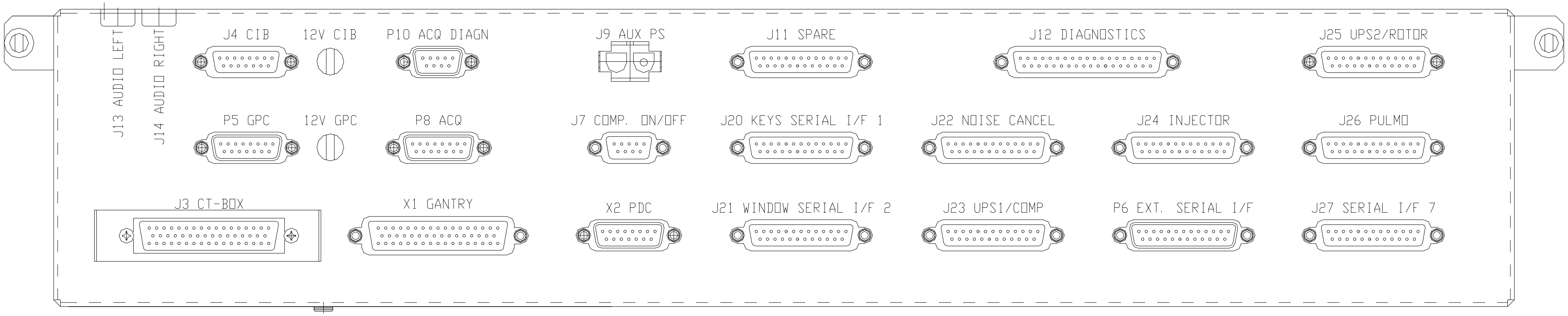

J13 AUDIO LEFT
J14 AUDIO RIGHT
J4 CIB
12V CIB
P10 ACQ DIAGN
J9 AUX PS
J11 SPARE
J12 DIAGNOSTICS
J25 UPS2/ROTOR
P5 GPC
12V GPC
P8 ACQ
J7 COMP. ON/OFF
J20 KEYS SERIAL I/F 1
J22 NOISE CANCEL
J24 INJECTOR
J26 PULMO
J3 CT-BOX
X1 GANTRY
X2 PDC
J21 WINDOW SERIAL I/F 2
J23 UPS1/COMP
P6 EXT. SERIAL I/F
J27 SERIAL I/F 7

Figure 2-15: Signal Distribution Board

Host Control Bridge Board

The Host Control Bridge Board (HCBB) is located in the O2 computer and its main task is to extend the PCI bus of the Host.

PCI Card

The HCBB has a 32 bit PCI Card (Clock 33MHz) throughput: 132 MB/sec.

EMI Shielded 4 Foot Cable

The EMI Shielded 4 Foot Cable is used to connect the Host Control Bridge to the IRS (back plane control bridge).

Power

The HCBB has a 5 V LED Power indication.

The Host Computer - O2 Workstation

The Host Computer is necessary for:

- Storing the software files
- Executing the software
- Storing and archiving of images
- Image manipulation and post processing
- Communication

The Host Computer is based on the Silicon Graphics O2 Workstation.

This section contains service and troubleshooting information for the Mx8000 workstation. It includes the following information, in the order listed:

- References to other relevant documentation and unpacking information.
- *“System First-Time Operation”* - Turning ON the workstation, logging in and out, checking the system hardware, setting date and time, turning the system OFF.
- *“Replacing Internal Mx8000 Modules”* - Installing, replacing and testing the following internal modules:
    - Memory expansion
    - Internal hard disk
    - Power supply
    - CD-ROM drive
- *“Installing External Mx8000 Peripherals”* - Connecting, testing and using the following external peripherals of the Mx8000 workstation:
    - External Floppy Drive
    - E.O.D. - Erasable Optical Disk Drive (EOD-8 option)
    - AMC - Laser Multi Imager Interface (AMC-4 option)

All the necessary information for the O2 Computer are described in:

- O2 Workstation Owners Guide—Hardware installation and troubleshooting
- O2 Workstation Service Guide

Installing the Mx8000 Workstation

Refer to the *Chapter 14 "Software Installation"*.

System First-Time Operation

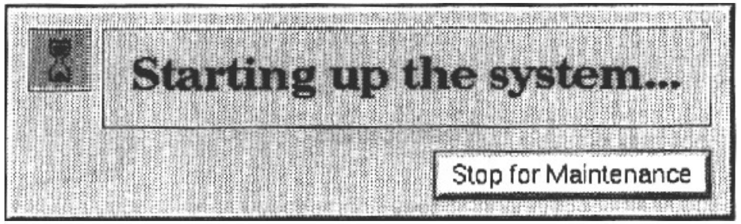
This section explains how to turn the system ON, log in, log out and turn the system OFF.

Turning On The Workstation

1. For details about the controls on the computer’s front panel, refer to the *O2 Workstation Owners Guide*.
2. To power ON the workstation, do as follows:
   a. Turn the power switch of the monitor ON. The switch is at the front of the monitor. The power indicator LED lights up when the monitor is turned ON.
   b. Turn ON the external SCSI devices.
   c. Turn ON the AMC-4 (if this option exists).
   d. Switch ON the power to the system, by pressing and releasing the power button.

When you power the system ON, the power indicator LED on the front panel is amber for a few seconds, before turning green. The system also plays a boot tune.

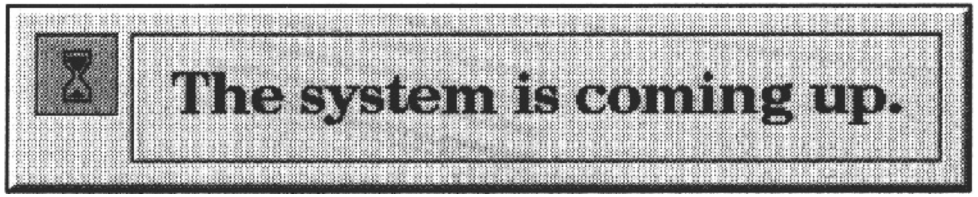
The system runs diagnostics tests. If all diagnostics tests are passed, the LED turns green, the system continues booting and the following message is displayed.



Starting up the system...

Figure 2-16: System Start-up Message

After a few seconds, the message shown below appears.



The system is coming up.

Figure 2-17: System is Coming Up Message

If you do not hear the boot tune or the LED is red and does not turn green, there may be a problem. To run some tests, refer to the *O2 Workstation Owners Guide*.

The system now boots the operating system.

If the system fails to boot, and/or the front panel LED is not green, refer to the *O2 Workstation Owners Guide*, Chapter 4, “Troubleshooting”.

Logging In and Out of the Workstation

After the system boots, the login screen appears.

The login screen usually has several login icons. After installation of the Mx8000 software, the following icons are displayed: **root**, **mx8000**, **shutdown**, **config** and **service**.

1. Double-click the **root** icon to login as a root to the system. After clicking the icon, you are required to provide the password. If the root password is defined, type it in, or press **<Enter>**. For the root password, contact Philips Connectivity Customer Support, Haifa.

⚠ CAUTION

THE **ROOT** ACOUNT IS TO BE USED BY THE SUPER USER.

DO NOT LOGIN AS ROOT, UNLESS YOU ARE FAMILIAR WITH THIS MODE. OTHERWISE, YOU MAY CAUSE DAMAGE TO THE SYSTEM.

2. To log out, move the mouse outside any window, press the right mouse button and select **Log Out**. Click **Yes** on the confirmation message **- Do you want to log out now?**

The Toolchest

The stack of toolchests in the top left hand corner of the screen (see *Figure 2-18*) provides a list of most of the system functions and programs. The system toolchest contains the **System** manager, which provides hardware information about your workstation. The System toolchest also contains the **Run Confidence Test** button, which is used to run the tests.

To expand a menu, move the cursor over a label on a toolchest, then press the left or right mouse button.

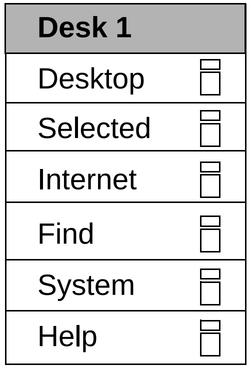


Figure 2-18: The Toolchest

Checking The System Hardware Inventory

Use the **hinv** command to display the system hardware inventory. This information includes CPU speed, main memory size, cache sizes, floating point unit, disk drives.

To activate the command, do the following:

1. Select **Unix Shell** from the Desktop toolchest to open a UNIX shell window. Inside the window, a prompt **IRIS 1#** appears. Move the mouse inside the window and type **hinv**. A list of the system hardware, such as the following, appears:

```
Video: MVP unit 0 version 1.4 with no AV Card or Camera
FLASH PROM version 4.12
On-board serial ports:2
On-board EPP/ECP parallel port
One 180 MHz[1] IP 32 Processor
FPU: MIPS R5000 Floating Point Co-processor Revision 1.0
CPU: MIPS R5000 Processor Chip Revision 2.1
Data cache size: 32 Kbytes
Instruction cache size: 32 Kbytes
Secondary unified instruction/data cache size: 512 Kbyte[2] on Processor 0
Main memory size [3]
Iris Audio Processor: Version A3 Revision 1
Integral Ethernet: ECO Version 1
CDROM: unit 4 on SCSI Controller 0
Disk Drive: unit 1 on SCSI Controller 0
CRM graphics installed
Integral SCSI Controller 1: Version ADAPTEC 7880
Integral SCSI Controller 0: Version ADAPTEC 7880
Vice: TRE
```

Note: This list does not include the IRS boards.

---

[1] Can be either 180 MHz or 200 MHz.

[2] Can be either 512 Kbytes or 1 MB.

[3] Size depends on your order.

Setting System Time and Date

The correct date and time should be set in the Mx8000 Workstation. To check and set the date and time do the following:

1. Login as **root**.
2. To check the date and time, type: **date <Enter>.**
3. To set the date and time (if incorrect), type **mmddHHMMyyyy <Enter>**, where:
   - **mm** indicates the month
   - **dd** indicates the day
   - **HH** indicates the hour (a 24 hour system)
   - **MM** indicates the minute
   - **yyyy** indicates the year

   For example: to set the date to February 14, 2002 and the time to 15:30, type **date 021415302002**

NOTE:

Type leading zeros if necessary. For example, instead of 2, type 02.

Turning The Workstation Off

There are three ways to shut your system OFF:

- For an orderly shutdown, use the **Shutdown** login to shut the Mx8000 software, the system software and power OFF.
- Use the power button to shut the system software and power OFF.
- Use the **Toolchest** menu to shut down the system software and return to the **System Maintenance** menu or to turn the power OFF.

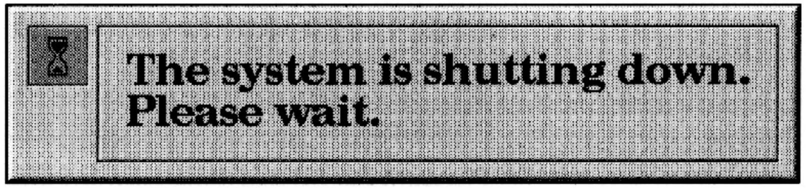
Using the Shutdown Login to Shut Down the System

If the Mx8000 software is already installed in the workstation, the Login screen includes a login named **Shutdown**. Using the shutdown login is the preferred way to shut down the workstation.

When you use the shutdown login, the Mx8000 software checks that it is safe to shutdown the workstation. For example, the software checks that remote workstations are not using the local database. After about a minute, the system shuts down and the workstation turns off. To activate shutdown, double-click the **Shutdown** icon.

Using the Power Button to Shut Down the System

To shut down the system, press and release the power button on the front of the workstation. It is not necessary to shut down the system software before pressing the power button, but it is recommended.



The system is shutting down.
Please wait.

Figure 2-19: System Power OFF Message

The message in *Figure 2-19* appears on your screen within a few seconds and the LED blinks green and amber. Then, the system shuts OFF automatically within the next minute.

⚠ CAUTION

AVOID DOUBLE-PRESSING THE POWER BUTTON. AFTER THE FIRST PUSH, THE SYSTEM PERFORMS A SHUTTING DOWN PROCESS DURING WHICH THE SYSTEM HARD DISK IS UPDATED WITH THE NEW DATA FROM THE MEMORY.

IF THE POWER BUTTON IS PRESSED TWICE, THIS PROCESS IS ABORTED AND THE SYSTEM SHUTS OFF IMMEDIATELY, CAUSING PROBABLE DATA LOSS AND DAMAGE TO SOME FILES ON THE HARD DISK.

Replacing Internal Mx8000 Modules

This section describes installation and testing of the internal modules. Some of the modules are field upgradeable options such as: MEM-4, MEM-5, MEM-6 and MEM-7.

⚠ CAUTION

THE SYSTEM'S INTERNAL COMPONENTS ARE SENSITIVE TO ELECTROSTATIC DISCHARGE. HANDLE THE PARTS CAREFULLY, AND WEAR THE WRIST STRAP TO AVOID DAMAGE.

DISCONNECT THE POWER CABLE BEFORE REMOVING ANY INTERNAL MODULE.

Before handling internal system components (like memory modules, ***flopticals*** (magneto-optical diskettes), hard disk) ground yourself to a metal part of the computer chassis or another ground connection. Use the wrist strap included with the memory modules. Put it around your wrist, making sure it is tight against your arm.

Replacing the System Module

For instructions, refer to the *O2 Workstation Owners Guide*.

Installing Memory Options (MEM-4, MEM-5, MEM-6 and MEM-7)

This section contains information about installation, replacement and checking of the RAM expansion modules inside the system. There are four banks of memory sockets in the system. Each bank contains two sockets. The basic system is shipped with 128 MB of RAM memory, organized in four DIMMs, installed in bank 1 and 2.

- MEM-4 adds an additional 64 MB for a total of 192 MB. The option contains two DIMMs (32 MB each) and should be installed in sockets 5 and 6, in addition to the basic 128 MB.
- MEM-5 adds an additional 128 MB for a total of 256 MB. The option contains four DIMMs (32 MB each) and should be installed in sockets 5, 6, 7 and 8 in addition to the basic 64 MB.

- MEM-6 adds an additional 128 MB. The option contains two DIMMs (64 MB each).
- MEM-7 adds an additional 256 MB. The option contains two DIMMs (128 MB each).

For information about installing and replacing the memory modules refer to the *O2 Workstation Owners Guide*, Chapter 2, “Installing or Removing Memory and Option Boards”.

Checking The New Memory

To confirm that you installed the memory modules correctly, check whether the system recognizes the new memory:

1. Turn on the power to the system. The system boots up and displays the login screen.

   If no picture appears on your screen and the LED on the front panel blinks red, one or more DIMMs are not installed correctly. Refer to the *O2 Workstation Owners Guide*, Chapter 4, “Troubleshooting”.

   At this stage the system starts the **Maintenance Monitor** utility.
2. Log in to the **root** account. When you log in, the default desk appears. The toolchests appear in the upper left-hand corner of the screen.
3. Choose **System Manager** from the **System** toolchest. A window showing hardware and the shared resources is displayed.
4. Look under **Hardware** for the line showing memory. The amount of memory shown in megabytes should equal the total memory (the amount of memory which existed previously in the system plus the amount of memory which have been installed).
5. If the system does not show the new total memory, the DIMMs may not be installed correctly or may be faulty.

MEM Option installation is complete.

NOTE:

You can also use the **hinv** command to check the memory size.

Replacing the Internal Hard Disk

Refer to the *O2 Workstation Owners Guide*, Chapter 3, “Installing or Removing Peripherals: Internal and External Devices”.

Replacing the Power Supply

Refer to the *O2 Workstation Owners Guide*, Chapter 5, "Ordering, Removing, and Installing Replacements Parts".

Replacing the CD-ROM Drive

Refer to the *O2 Workstation Owners Guide*, Chapter 5, "Ordering, Removing, and Installing Replacements Parts".

Installing External Mx8000 Peripherals

This section contains all the necessary information required to install and test external peripherals like the floppy drive, EOD-8, AMC-4. For details regarding EOD and CD-ROM models, refer to the relevant sections.

Installing the EOD Drive

This section provides the following information about installing the EOD (Erasable Optical Disk) drive:

- Setting up the driver
- Choosing and using optical disks
- Front panel controls, operating instructions and troubleshooting information

Preparing the Environment

The following environmental factors should be considered for optimal performance of the EOD drive:

- **Clearance requirements -** A minimum of 70-80 mm (3 in.) is required behind the rear panel and in front of the optical disk drive, to allow air circulation.
- **Location requirements -** Position the drive away from sources of particulate contamination, such as frequently-used doors and walkways, printers, stacks of supplies that collect dust, and smoke-filled rooms.

Connecting the EOD Drive to the System

⚠ CAUTION

DO NOT TRY TO CONNECT OR DISCONNECT THE EOD DRIVE FROM THE SCSI BUS WHILE THE SYSTEM IS ON.

1. Chain the EOD to the floppy drive, using the supplied 50 cm SCSI-1/SCSI-1 cable (PN 475-7169-1907).
2. If you have a second EOD, chain it to the first EOD, using a SCSI-1/SCSI-1 cable.
3. Plug the active terminal into the free port on the rear panel of the last device in the chain.
4. Set the SCSI ID to 3. For details, refer to the *O2 Workstation Owners Guide*.

NOTE:

The maximum combined cable length of all external SCSI cables should not exceed two meters, including the internal bus length of all external devices. The EOD drive internal cable length is 0.3 m.
Remember that SCSI ID 5 is already used by the floppy drive.

5. To check that the hardware installation is OK (namely, that the EOD drive is reconized by the system) use the **hinv** command.

To configure the EOD drive, refer to *“Device Configuration” on page 8-17.*

NOTE:

For optimum performance and reliability, we recommend the use of optical disks supplied for option ECD-4.
Before turning ON the system, remember to power the EOD Drive or other external devices first, and then the system, to make sure that the device is recognized.

⚠ CAUTION

NEVER TURN OFF POWER TO THE EOD DRIVE WHILE SYSTEM IS ON. FIRST SHUT DOWN THE SYSTEM THEN THE DRIVE, OR DATA STORED ON THE CARTRIDGE MAY BE LOST.

Formatting a Cartridge

The EOD cartridge comes already low-level formatted by the manufacturer, therefore only high-level format is required.

To perform high-level format, do the following:

1. Insert the EOD cartridge into the EOD drive.
2. Right-click the **EOD** icon, keep it pressed, and from the popup menu select **Format**.
3. Formatting takes about one minute.

Reading and Writing to the EOD Drive

Before reading or writing to a new cartridge, format it first.

To read or write to the EOD drive, insert a cartridge into the drive, and use the EOD device in the Archive Manager **Window**. For definition of an EOD device refer to *“Device Configuration” on page 8-17*.

Ejecting a Cartridge from the EOD Drive

Eject the cartridge by right-clicking the **EOD** icon, and selecting **Eject** from the pop-up menu.

If the cartridge does not come out, eject it mechanically as described in the next section.

Ejecting a Cartridge Mechanically

The EOD drive does not automatically eject an optical cartridge if a power failure occurs. An eject tool is shipped with the drive to eject a cartridge manually.

To remove the cartridge from the EOD drive:

1. Shut down the system (using the **Shutdown** icon, or by pressing the **ON/OFF** button).
2. Disconnect the power to the drive.
3. Insert the eject tool into the small round hole on the drive front panel.
4. If you have an HP EOD drive, turn the eject tool clockwise (to the right) until the disk is ejected (approximately 20 complete rotations).

   If you have a SONY EOD drive, firmly press the eject tool into the small hole located on the front panel of the drive

NOTE:

After manually ejecting a cartridge, the drive remains in eject position until power is restored. At that time, the drive automatically resets itself.

Choosing an Optical Disk

Optical disks may be up til 4.1 GB capacity (both sides).

Optical disks may be rewritable disks or write-once.

Labeling an Optical Disk Cartridge

Adhesive labels are included with each disk. Apply the labels to the optical disk where it does not obstruct the movement of the metal shutter. On side A of an optical disk, put the label just to the left of the metal shutter. On side B, put the label just to the right of the metal shutter. See *Figure 2-20* for proper placement of labels on a disk.

CAUTION

IF A LABEL IS APPLIED INCORRECTLY, THE DISK CARTRIDGE MAY GET CAUGHT IN THE DRIVE.

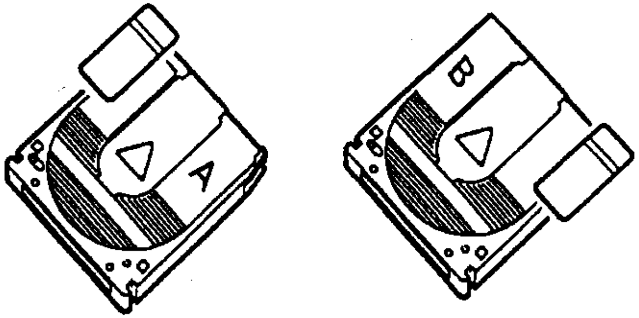


Figure 2-20: Correct Label Positions

Write-protecting an Optical Disk

Each side of an optical disk can be write-protected by sliding the write-protect button in the direction of the arrow on the cartridge (see *Figure 2-21*).

- On rewritable optical disks, use the write protect button to ensure data safety for files that were previously written to the disk and to prevent additional files from being written to the disk.
- On write-once optical disks, existing files cannot be altered or erased regardless of the write-protect button position. In this case, using the write-protect button prevents any additional files being written to a disk.

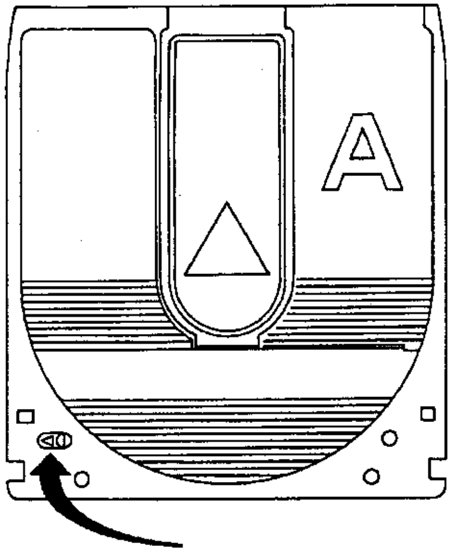


Figure 2-21: Write-Protect Button Location

Maintaining an Optical Disk

Observe the following guidelines to maintain your disk in good condition:

- Do not expose the disk to extreme magnetic fields.
- Do not expose the disk to dust particles.
- Do not expose the disk to extreme temperatures or extreme humidity (refer to *"Preparing the Environment" on page 2-42*.)
- Do not drop the disk.
- Do not open the shutter and touch the disk surface.
- Do not take the disk cartridge apart.
- Do not clean the disk's surface.
- Do not insert disks with loosely attached labels into the drive.
- Remove the old label before applying a new one.
- Store the disk in a clean, safe place when it is not in use.
- Make sure it is write-protected when stored.

Troubleshooting Tips

If you are having problems such as: EOD cannot be accessed, cartridge cannot be ejected, check the following:

- The power cord connection is tight.
- The SCSI cables are connected properly.
- The power switch on the rear panel is ON.
- The software drives are loaded properly.
- The SCSI ID is unique.
- SCSI termination is properly installed.
- Main power to the drive is stable.
- Cartridge is not write-protected.

IRS (Image Reconstruction System)

The Image Reconstruction system enables:

- Acquisition of RAW data from the Gantry
- Storage of RAW data
- Processing of RAW to the Image (Prep, Filter, B. P.)
- Fast DMA transfer of Reconstructed Image to the Host
- Off-line background reconstruction of use defined groups of RAW

The IRS is based on a PCI bus back plane. The boards are either proprietary or third party products.

The Host is a PCI bus based system. The Host is a Silicon Graphics PC running under UNIX.

Architecture

The architecture of the Image Reconstruction System is shown in *Figure 2-22*. It includes:

- A processor for the reconstruction of the image
- Memory and disks as data storage
- Data input interface to the Data Acquisition System (DAS) in the Gantry
- Connection to the Host

The IRS also serves as an interface board (CI Board) to the Master Control Processor in the Gantry.

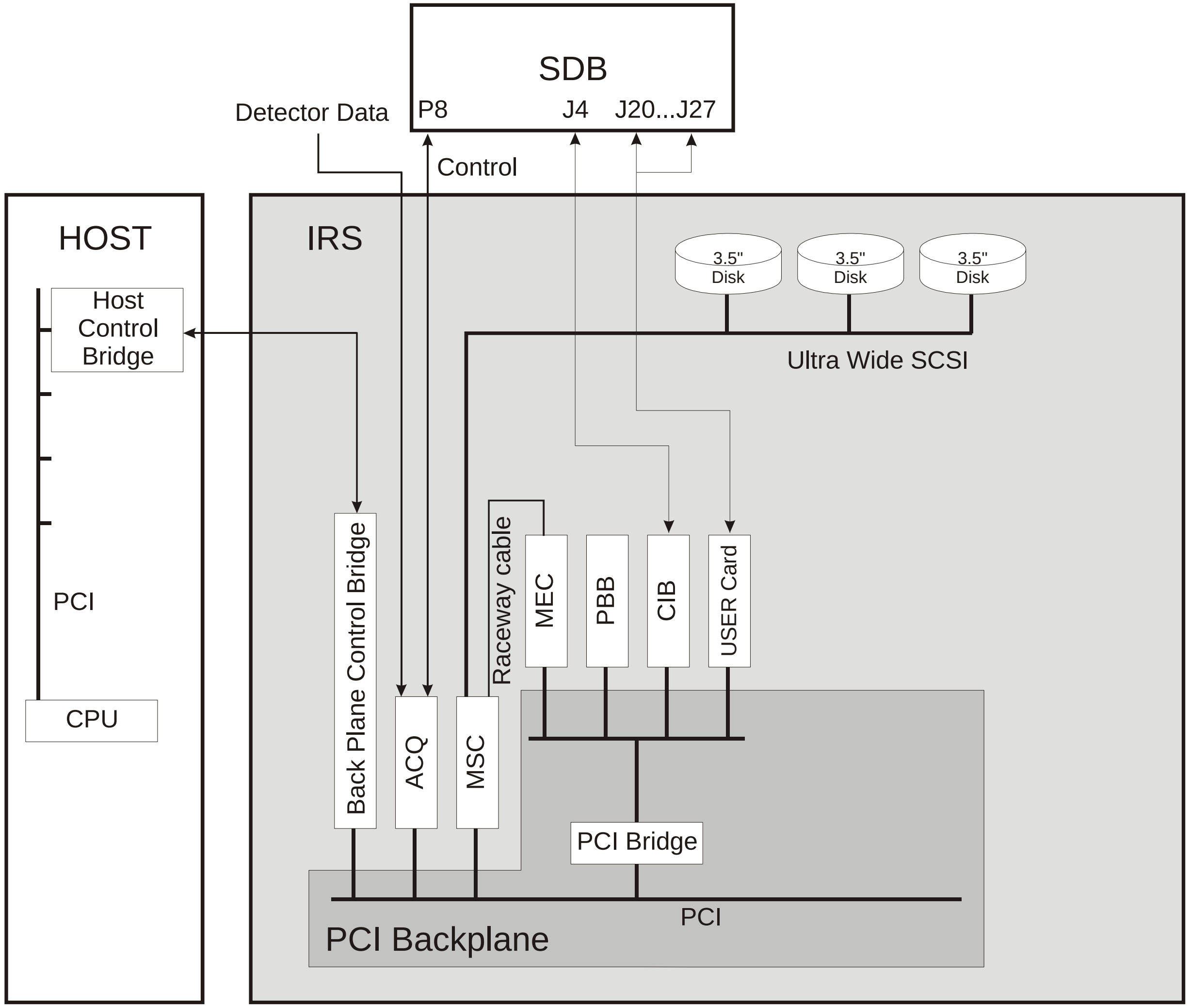

SDB
Detector Data
P8
J4
J20...J27
Control
HOST
IRS
Host Control Bridge
3.5" Disk
3.5" Disk
3.5" Disk
Ultra Wide SCSI
PCI
CPU
Back Plane Control Bridge
ACQ
MSC
Raceway cable
MEC
PBB
CIB
USER Card
PCI Bridge
PCI
PCI Backplane

Figure 2-22: Overview of the IRS

24 SHARC Configuration - for Mx8000 Basic and Mx8000 Dual (Optional) Systems

The 24 SHARC configuration for Mx8000 and Mx8000 Dual systems (optional) includes (see *Figure 2-23*):

- ACQ Card
- MERCURY System Card
- MERCURY Expansion Card (2x)
- 18.3 GB Ultra Wide SCSI Disks (3x)
- PBB Card
- CIB Card
- Multi Serial Card
- PCILK Card

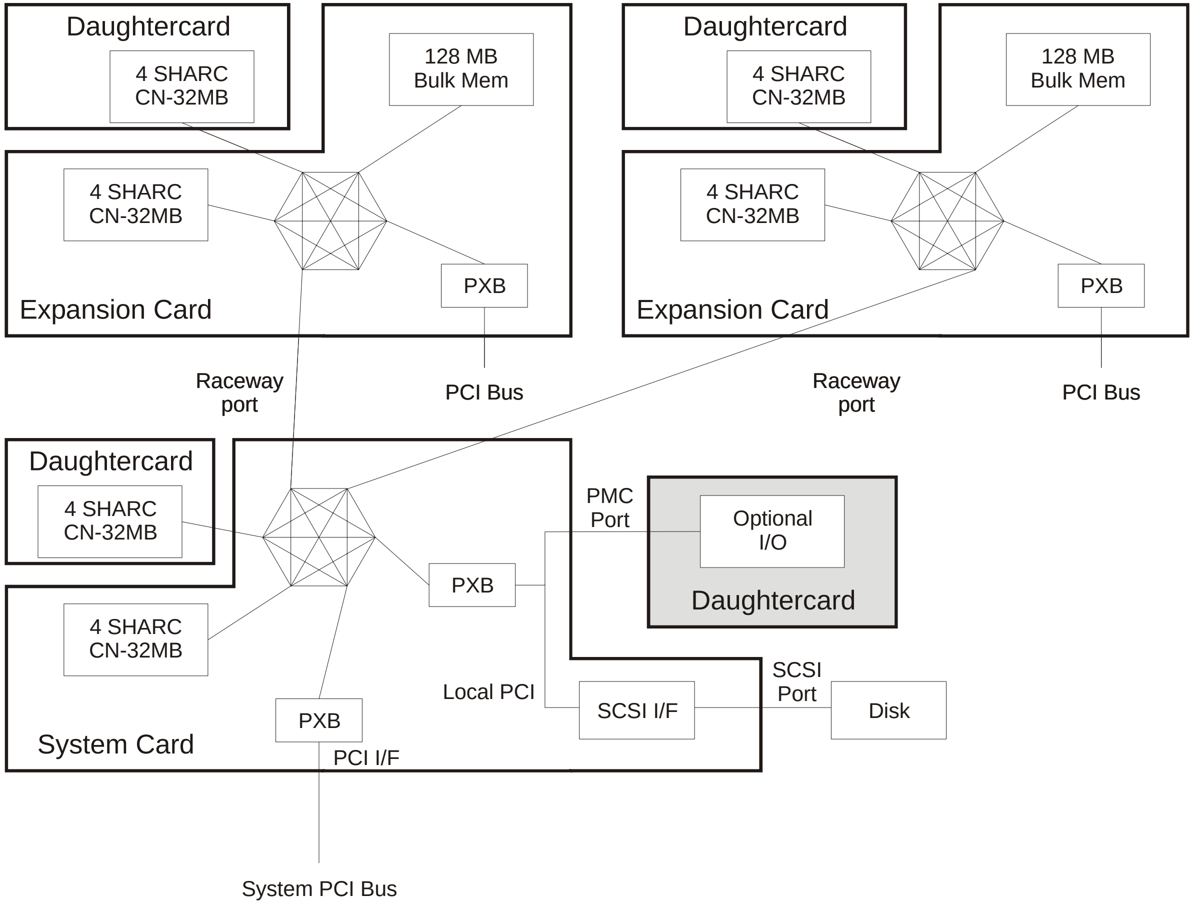

Daughtercard
4 SHARC CN-32MB
128 MB Bulk Mem
4 SHARC CN-32MB
PXB
Expansion Card
Daughtercard
4 SHARC CN-32MB
128 MB Bulk Mem
4 SHARC CN-32MB
PXB
Expansion Card
Raceway port
PCI Bus
Raceway port
PCI Bus
Daughtercard
4 SHARC CN-32MB
PMC Port
Optional I/O
Daughtercard
PXB
4 SHARC CN-32MB
SCSI Port
Local PCI
SCSI I/F
Disk
PXB
System Card
PCI I/F
System PCI Bus

Figure 2-23: 24 SHARC System Configuration

The Upgrade Option supports the reconstruction of eight images/second (512 matrix for large FOV body; ultra fast mode-0.5 second scan).

16 SHARC Configuration - for Mx8000 Dual Systems

The 16 SHARC configuration for Mx8000 Dual systems includes (see *Figure 2-24*):

- ACQ Card
- MERCURY System Card
- MERCURY Expansion Card
- 18.3 GB Ultra Wide SCSI Disks (3x)
- PBB Card
- CIB Card
- Multi Serial Card

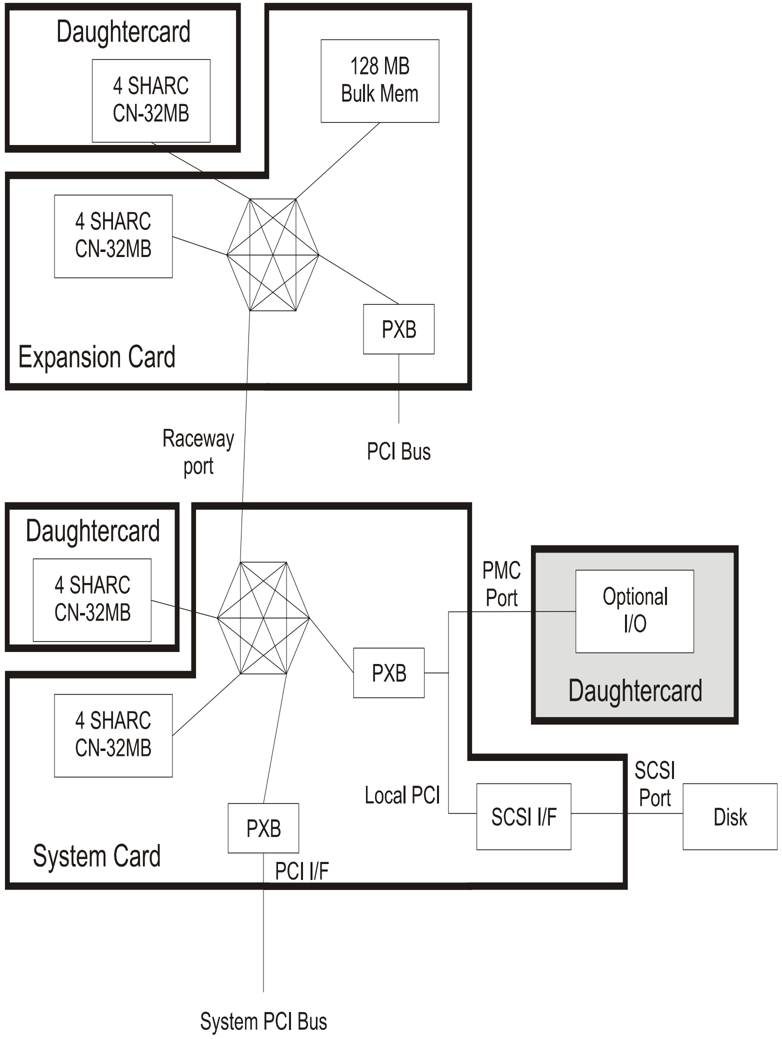

Daughtercard
4 SHARC CN-32MB
128 MB Bulk Mem
4 SHARC CN-32MB
PXB
Expansion Card
Raceway port
PCI Bus
Daughtercard
4 SHARC CN-32MB
PMC Port
Optional I/O
PXB
Daughtercard
4 SHARC CN-32MB
SCSI Port
Local PCI
SCSI I/F
Disk
PXB
System Card
PCI I/F
System PCI Bus

Figure 2-24: 16 SHARC System Configuration

ON/OFF Switch

The ON/OFF Switch turns the power ON/OFF to the IRS Box.

LEDs

5 VDC

FAN

The fan power (12 VDC) is supplied from the CIB board.

Mercury Cards

The Mercury cards are:

- System Card
- Expansion Card
- PCILK Card

The number of cards depends on the computation power required from the system.

The main functions of the Mercury Cards are to:

- Archive Raw Data
- Prep
- Rebinning
- Filter
- Ring Connection

Mercury System Card - Old Revision

The Mercury System Card consists of the following (see *Figure 2-25*):

- **SHARC Processing Node:** Four 21060 40 MHz processors and 32 MB of DRAM
- **Host PCI Interface:** MERCURY PXB PCI to RACEway Bridge
- **RACEway Interconnect:** Mercury Cross bar ASIC for multiple, simultaneous 160 MB/second data path between elements and cards
- **SCSI Interface:** Ultra wide SCSI, Maximum Transfer Rate 14 MB
- **Processor Daughtercard Interface:** Provides attachment of additional Processing Node

The SHARC Node on the System Card will be a Quad Architecture Node. The node consists of four 21060 processors, a Mercury ZCE ASIC (3.3 V) and 8, 16 or 32 MB of DRAM. The SHARC chip is the 21060, 5 V, 40 MHz version (or higher, if Mercury decides to use newer chip versions). The node architecture is illustrated in *Figure 2-26*.

Each board has a unique serial number which must be inserted into a configuration file.

There is a clock jumper on the system board. The clock jumper selects the clock master. Only one board per RACEway can be the master clock.

Larger systems can consist of multiple base cards. The base cards will communicate via the RACEway connection. This interconnect will be a cable.

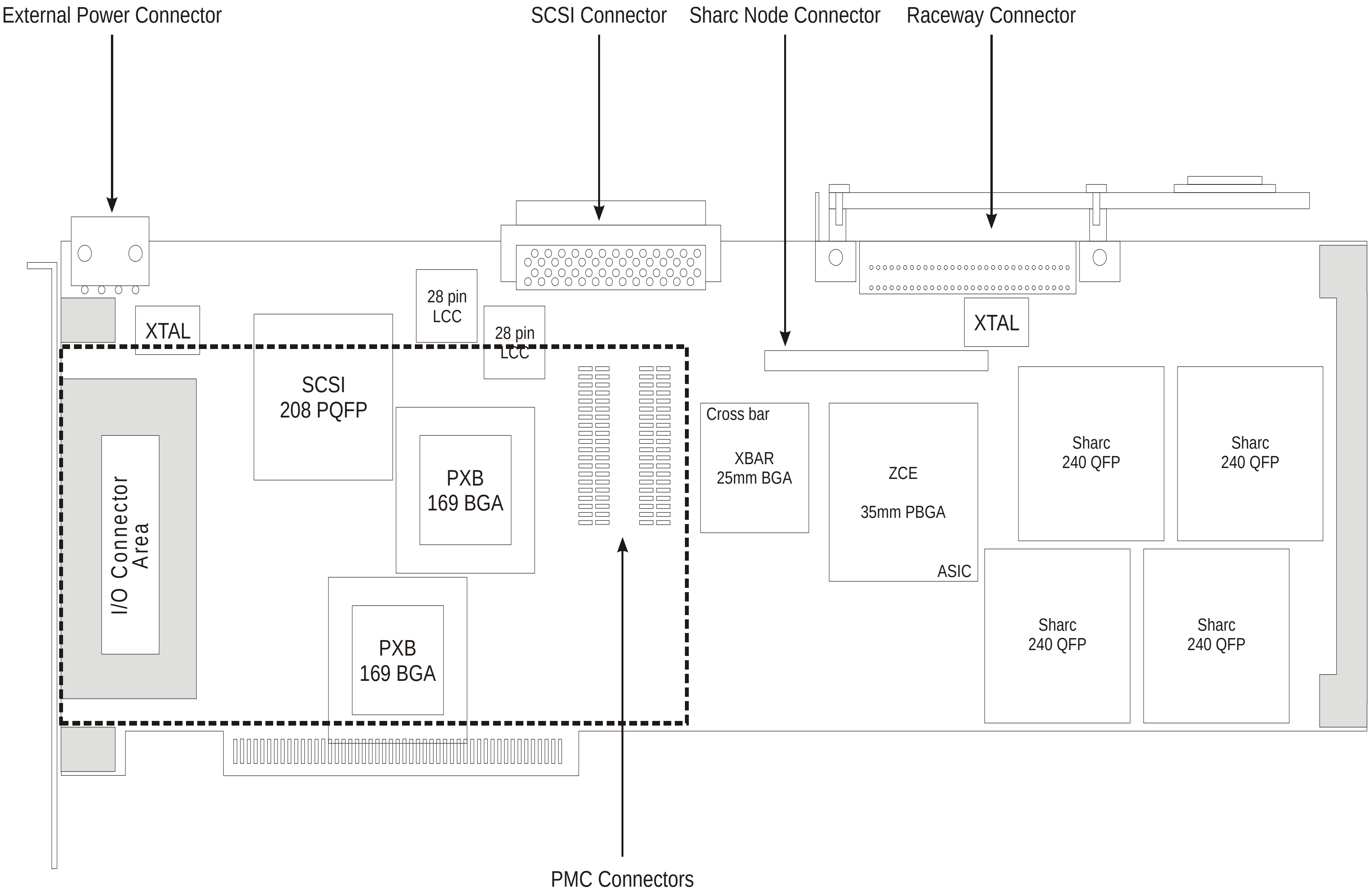

External Power Connector
SCSI Connector
Sharc Node Connector
Raceway Connector
XTAL
28 pin
LCC
28 pin
LCC
XTAL
SCSI
208 PQFP
PXB
169 BGA
PXB
169 BGA
I/O Connector
Area
Cross bar
XBAR
25mm BGA
ZCE
35mm PBGA
ASIC
Sharc
240 QFP
Sharc
240 QFP
Sharc
240 QFP
Sharc
240 QFP
PMC Connectors

Figure 2-25: System Card

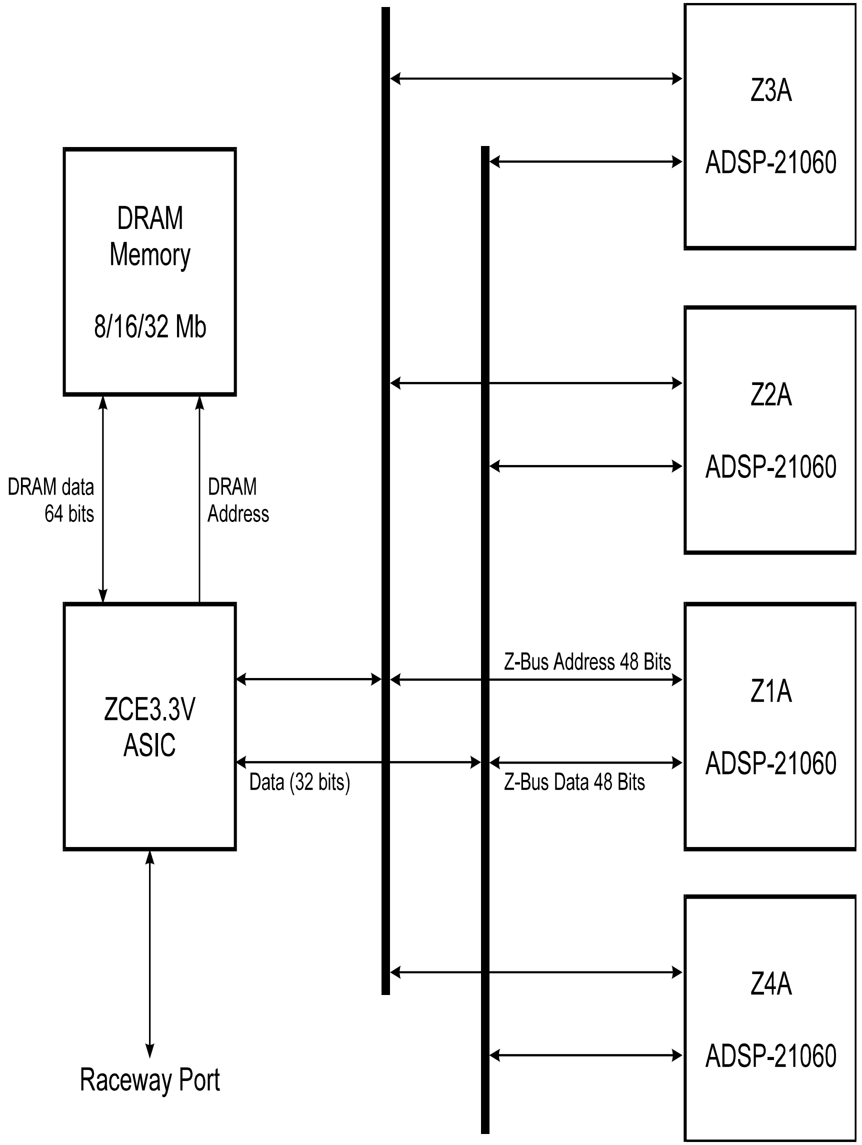

Z3A
ADSP-21060
DRAM
Memory
8/16/32 Mb
Z2A
ADSP-21060
DRAM data
64 bits
DRAM
Address
Z-Bus Address 48 Bits
Z1A
ADSP-21060
ZCE3.3V
ASIC
Data (32 bits)
Z-Bus Data 48 Bits
Z4A
ADSP-21060
Raceway Port

Figure 2-26: SHARC Node Architecture

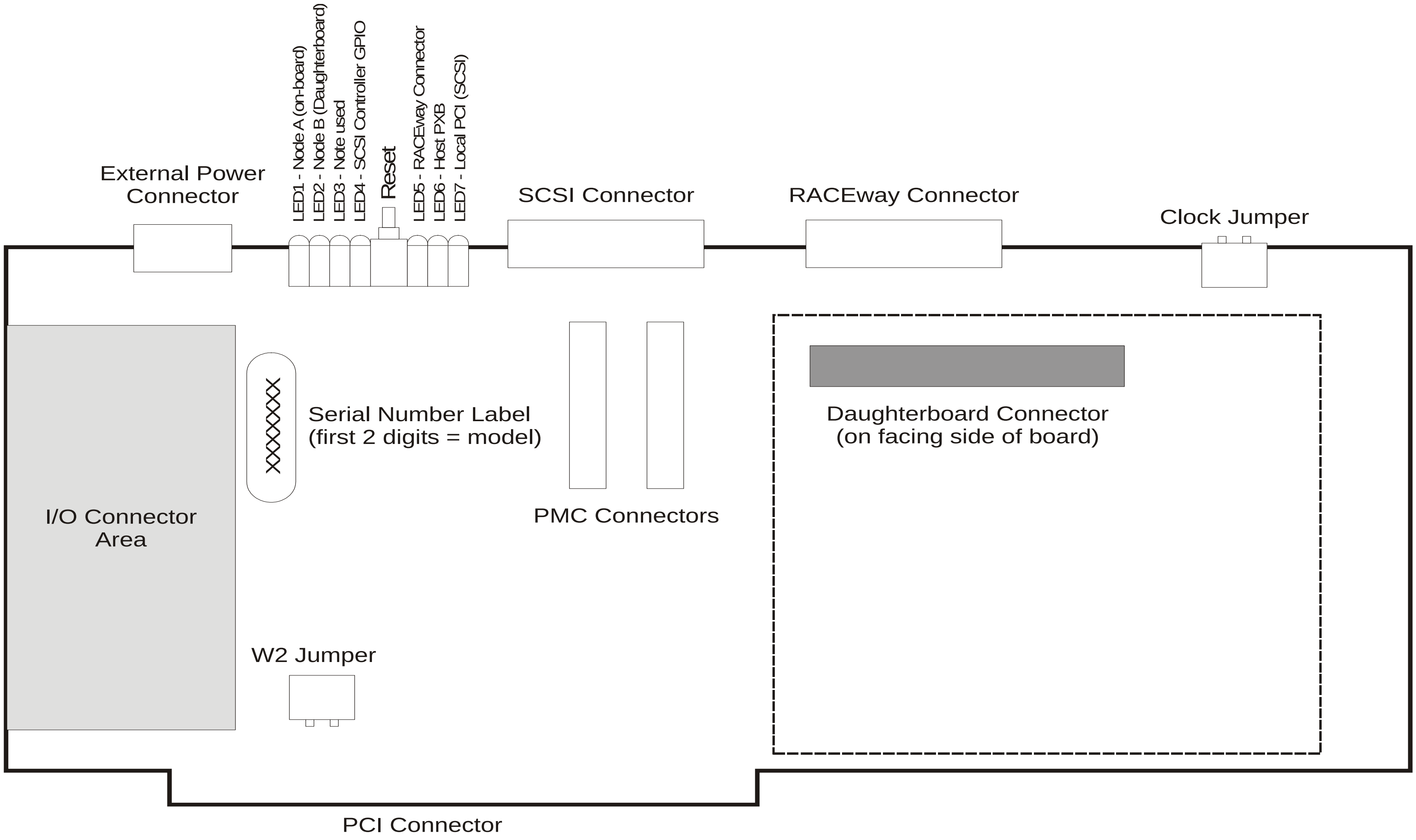

External Power Connector
LED1 - Node A (on-board)
LED2 - Node B (Daughterboard)
LED3 - Note used
LED4 - SCSI Controller GPIO
Reset
LED5 - RACEway Connector
LED6 - Host PXB
LED7 - Local PCI (SCSI)
SCSI Connector
RACEway Connector
Clock Jumper
XXXXXXX
Serial Number Label
(first 2 digits = model)
Daughterboard Connector
(on facing side of board)
I/O Connector Area
PMC Connectors
W2 Jumper
PCI Connector

Figure 2-27: LEDs Layout

Mercury Expansion Card - Old Revision

The Mercury Expansion Card consists of the following:

- **SHARC Processing Node:** Four processors and 32 MB of DRAM
- **Bulk Memory:** Up to 4 x 32 MB Modules (128 MB total)
- **Host PCI Interface:** Mercury PXB PCI to RACEway bridge
- **RACEway Interconnect:** Mercury Crossbar ASIC for multiple, simultaneous 160 MB/second data path between elements and cards
- **Processor Daughtercard Interface:** Provides attachment of an additional Processing Node.

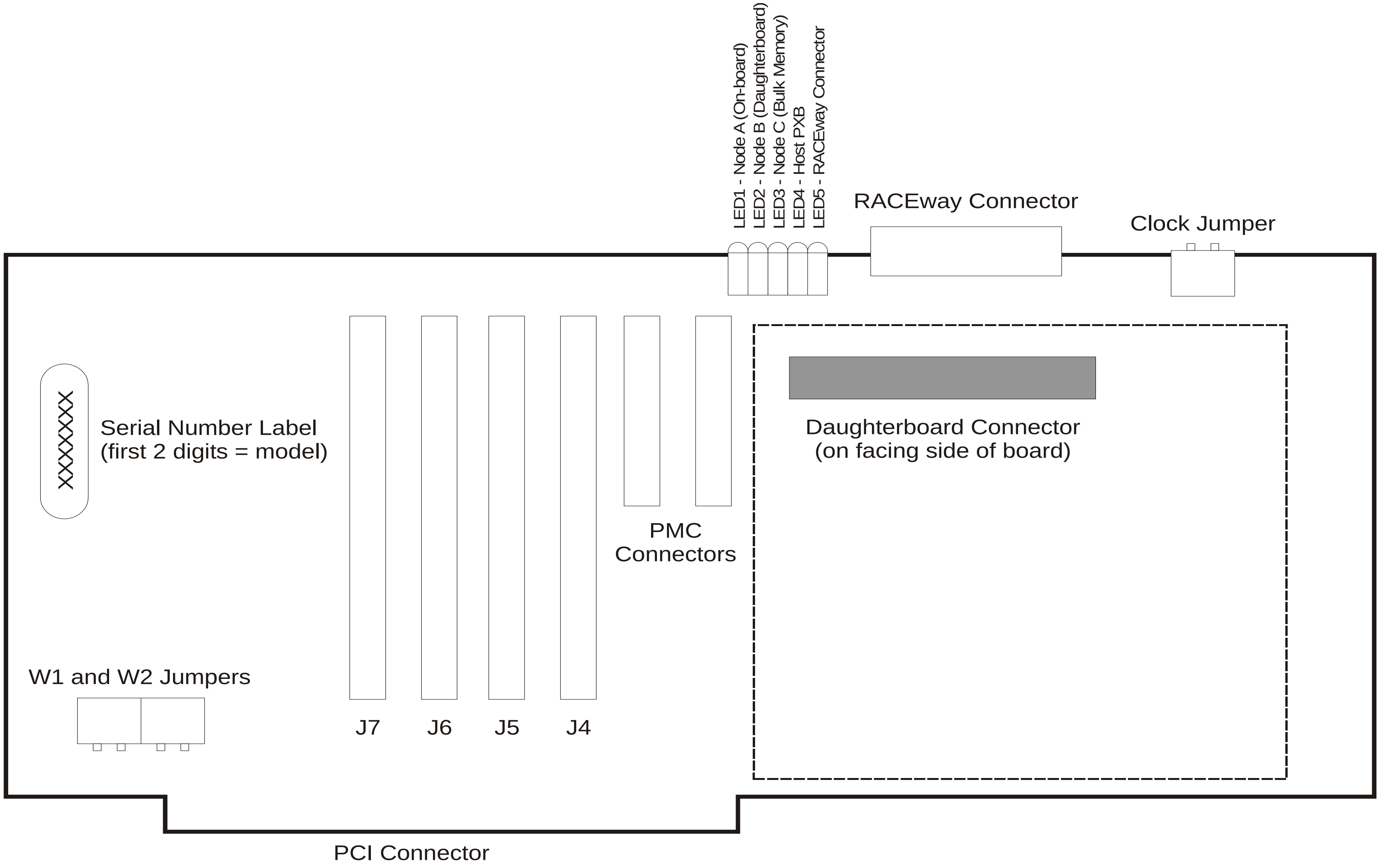

LED1 - Node A (On-board)
LED2 - Node B (Daughterboard)
LED3 - Node C (Bulk Memory)
LED4 - Host PXB
LED5 - RACEway Connector
RACEway Connector
Clock Jumper
XXXXXXX
Serial Number Label
(first 2 digits = model)
Daughterboard Connector
(on facing side of board)
PMC
Connectors
W1 and W2 Jumpers
J7
J6
J5
J4
PCI Connector

Figure 2-28: LEDs Layout of PCI Expansion Card (PCS1Q32H-D2)

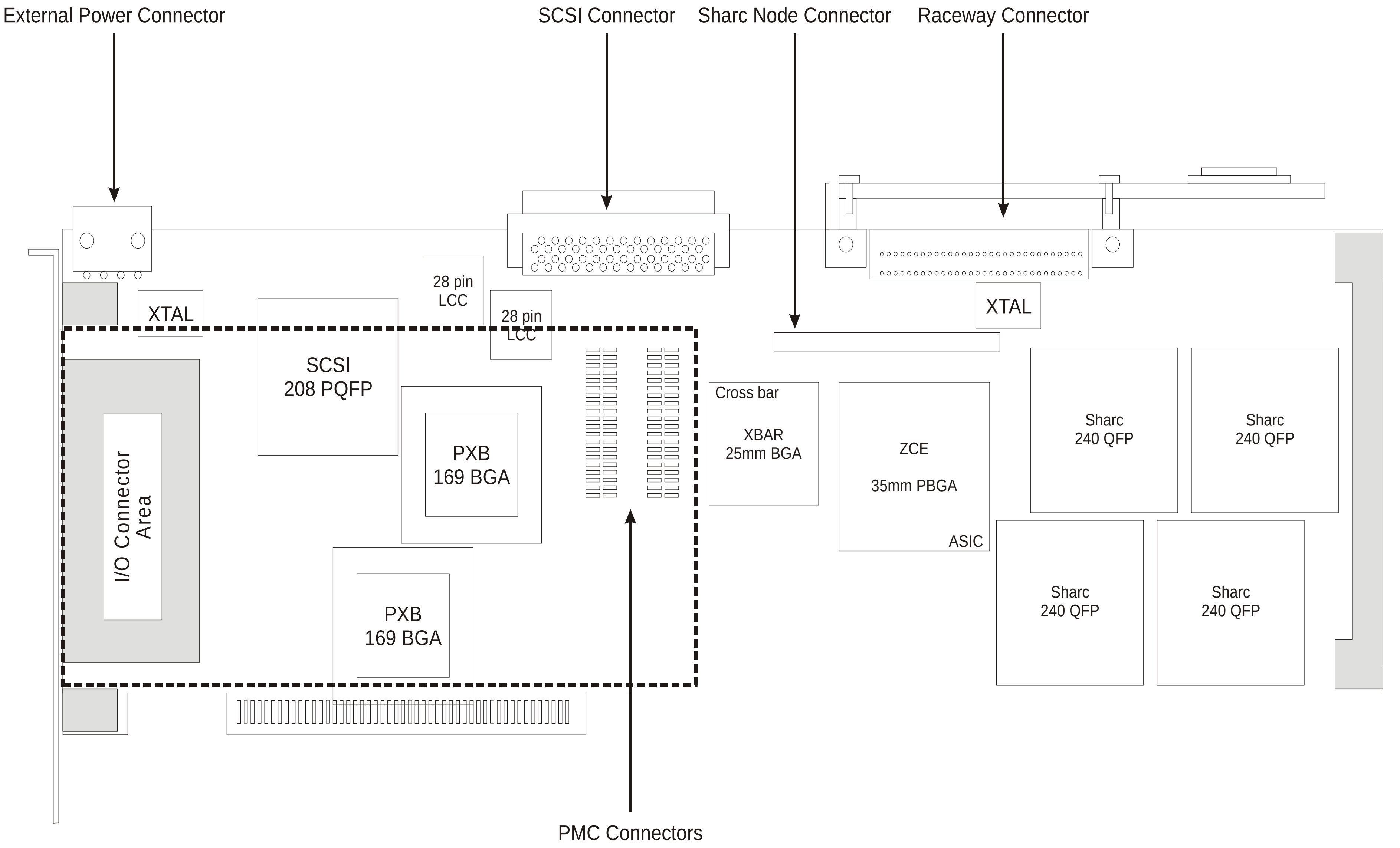

External Power Connector
SCSI Connector
Sharc Node Connector
Raceway Connector
XTAL
28 pin
LCC
28 pin
LCC
XTAL
SCSI
208 PQFP
I/O Connector
Area
PXB
169 BGA
PXB
169 BGA
Cross bar
XBAR
25mm BGA
ZCE
35mm PBGA
ASIC
Sharc
240 QFP
Sharc
240 QFP
Sharc
240 QFP
Sharc
240 QFP
PMC Connectors

Figure 2-29: Expansion Card (PCS1Q32H-D2)

Mercury Daughter Card - Old Revision

The Daughter card is a quad SHARC Node for attachment to the system or to the Expansion Motherboard. The Daughter card consists of the following:

- SHARC Processing Node
- Four-21060 (40 MHz) Processor
- 32 MB of DRAM

The Daughter card is mounted on the expansion card and is an integral part of it.

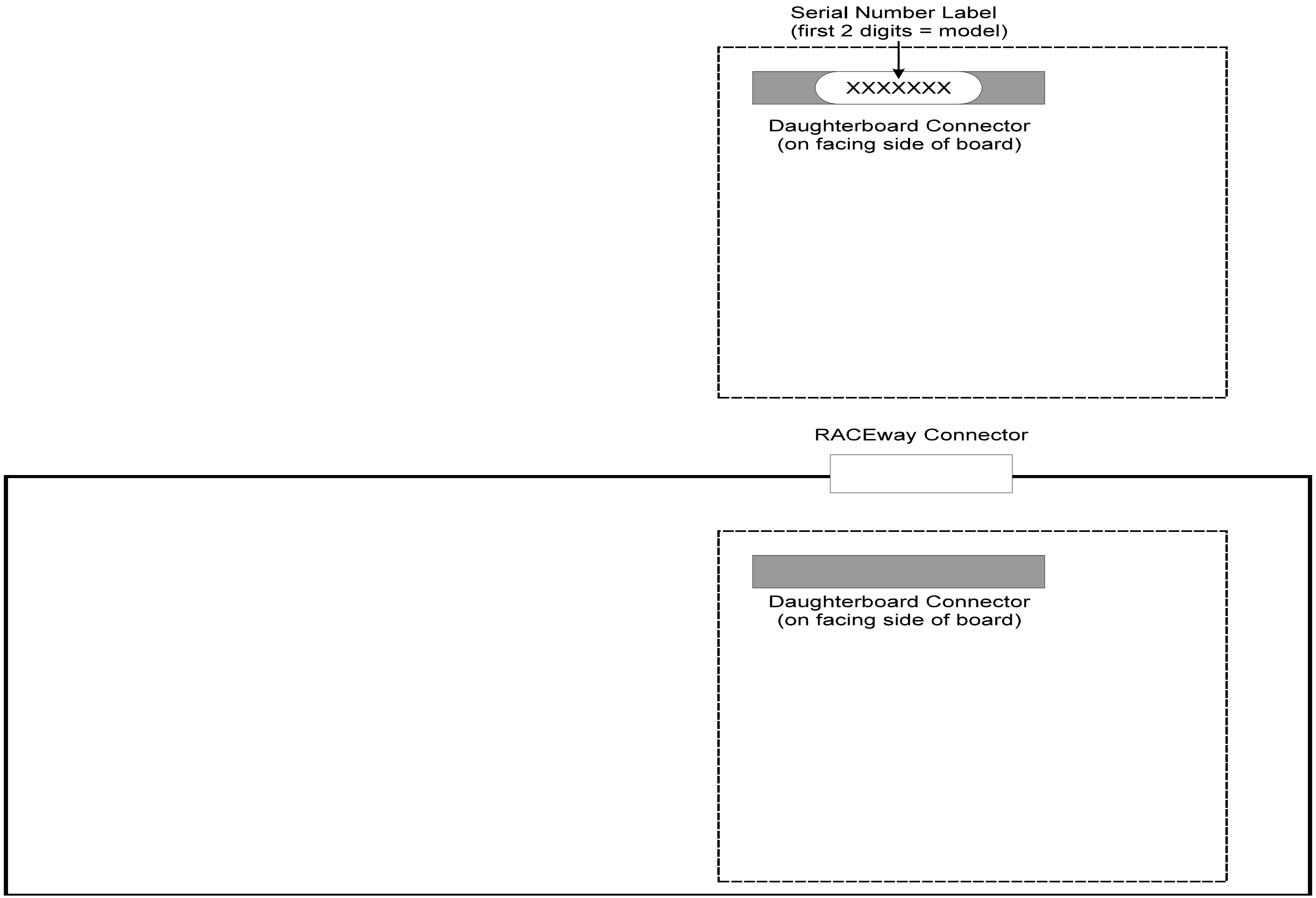

Serial Number Label
(first 2 digits = model)
XXXXXXX
Daughterboard Connector
(on facing side of board)
RACEway Connector
Daughterboard Connector
(on facing side of board)

Figure 2-30: Four Processor SHARC Daughter Card

CAN Interface Board (CIB)

The CAN Interface Bus (CIB) is the Control Interface between the Host and the Gantry.

It is a short PC board designed for PCI Bus, located in the IRS Assembly, Slot 7.

The main functions of the CIB are as follows:

- CAN bus interface
- Interface to the temperature switches
- STOP Circuit access
- Power Supply for the Scan Control Unit

The Stop Report Circuit

The Stop Report Circuit can be interrupted by issuing a command to the Local Microcontroller.

During Power ON, the contact is closed; during Power OFF or local Microcontroller RESET, the contact is OPENED. The Stop Report Circuit is CLOSED after initialization.

Power Supply

The CIB is supplied with 12 VDC from the IRS power supply. This voltage is supplied also to the Fan in the IRS crate.

CAN Interface

The CIB is the interface of the Host to the Gantry via the CAN bus.

The CAN interface supports data transfer rates of up to 100 KB/second.

A read buffer on the board stores up to 1,000 CAN telegrams for the ICS.

The CAN controller is an active card. An interrupt is asserted to the PCI bus, when a telegram is stored in the Read Buffer.

The PCI Multiserial card provides eight asynchronous high speed Serial Ports with data transmission rates of up to 115 K baud.

Two ports support the RS 232 signals RTS, CTS DTR, DSR and DCD. Transient voltage suppression is provided on all serial lines.

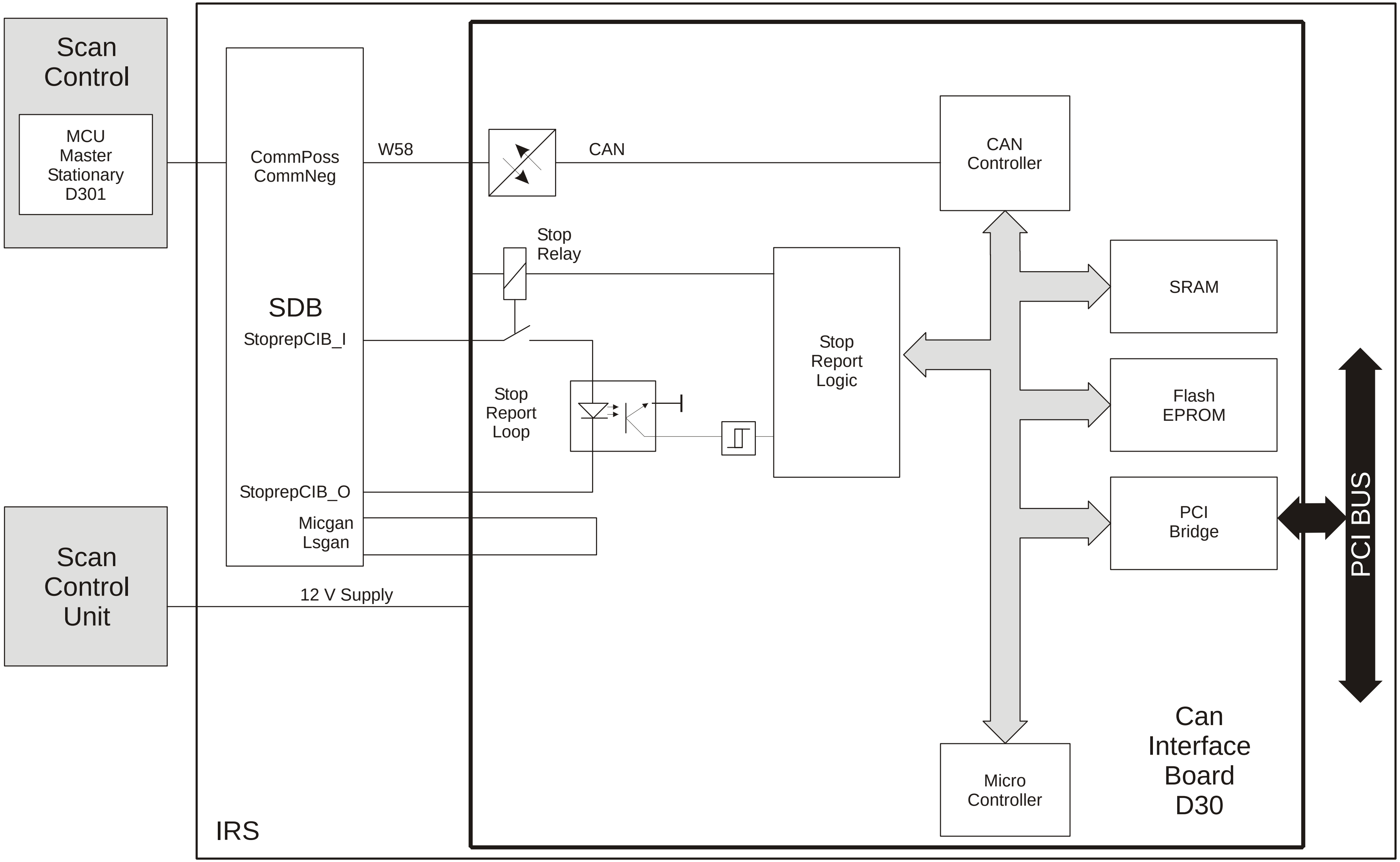

Scan Control
MCU Master Stationary D301
Scan Control Unit
SDB
CommPoss
CommNeg
StoprepCIB_I
StoprepCIB_O
Micgan
Lsgan
W58
CAN
CAN Controller
Stop Relay
Stop Report Loop
Stop Report Logic
SRAM
Flash EPROM
PCI Bridge
PCI BUS
12 V Supply
Micro Controller
Can Interface Board D30
IRS

Figure 2-31: CIB Multiserial Card

Serial Ports

- Serial Port 1 (SI_1) supports the keys in the Scan Control Unit.
- Serial Port 2 (SI_2) supports the windowing in the Scan Control Unit.
- Serial Port 3 supports the Gantry Noise Consolation Intercom.
- Serial Port 4 supports the UPS in the PDC for the Computer Rack. This serial port uses CTS, DTR and DCD control signals.
- Serial Port 5 supports the injector which is connected to the Gantry.
- Serial Port 6 supports UPS-2 in the PDC optional for the DMS uses CTS-2, DTR_2 and DCD_2 control signals.
- Serial Port 7 supports the PULMO option which is connected to the Gantry.
- Serial Port 8

Parallel Backprojector Board

The Backprojector Board, by using programmable processors is able to process one set of projections, while it backprojects the previous set (see *Figure 2-32*).

The processing unit consist of three PBA (Parallel Backprojector ASIC's) and each has four parallel backprojector units on it, thus four projections can be accumulated to the image concurrently. While the PBA's are computing, the next set of projections can be loaded to the input buffer.

The PBB consist of several functional blocks:

- PCI Control
  - Special chip interface to the board to the IRS via PCI bus
  - DMA interface for the incoming tasks which can operate as the DMA master as well as DMA target
- DMA interface for the transfer of the resulting image to a memory at the PCI bus, which can operate as DMA master as well as DMA target.

PCI_BUS

There is one PCI bus interface used to transfer data to and from the PBB. The Parallel Backprojector Board is also controlled via the PCI bus.

ID-PROM

The ID-PROM is connected via a serial link to the PCI DMA and contains setup data such as the configuration register and board specific data.

Input Buffer

The Input Buffer consists of a static RAM memory with 32 KB * 32 bit. The buffer stores the incoming task set (projections and parameters) while the backprojection pipeline is operating. The task flag resides at the input buffer control.

PBA

The parallel backprojector ASICs include the arithmetic for the backprojection algorithm. Each PBA has four parallel backprojector units (PBU) on it, thus four projections can be accumulated to the image. The PBA operates at 40 MHz.

A full backprojection cycle (including the backprojection of 12 projections to a 512 x 512 pixel image, the load of a task set and the necessary handshake) lasts less than 8 ms.

Image Memory

The image memory stores the temporary image. It consists of four SDRAM’s of 1 MB * 64 bit each and the ASIC Flora, which operates as an SDRAM controller.

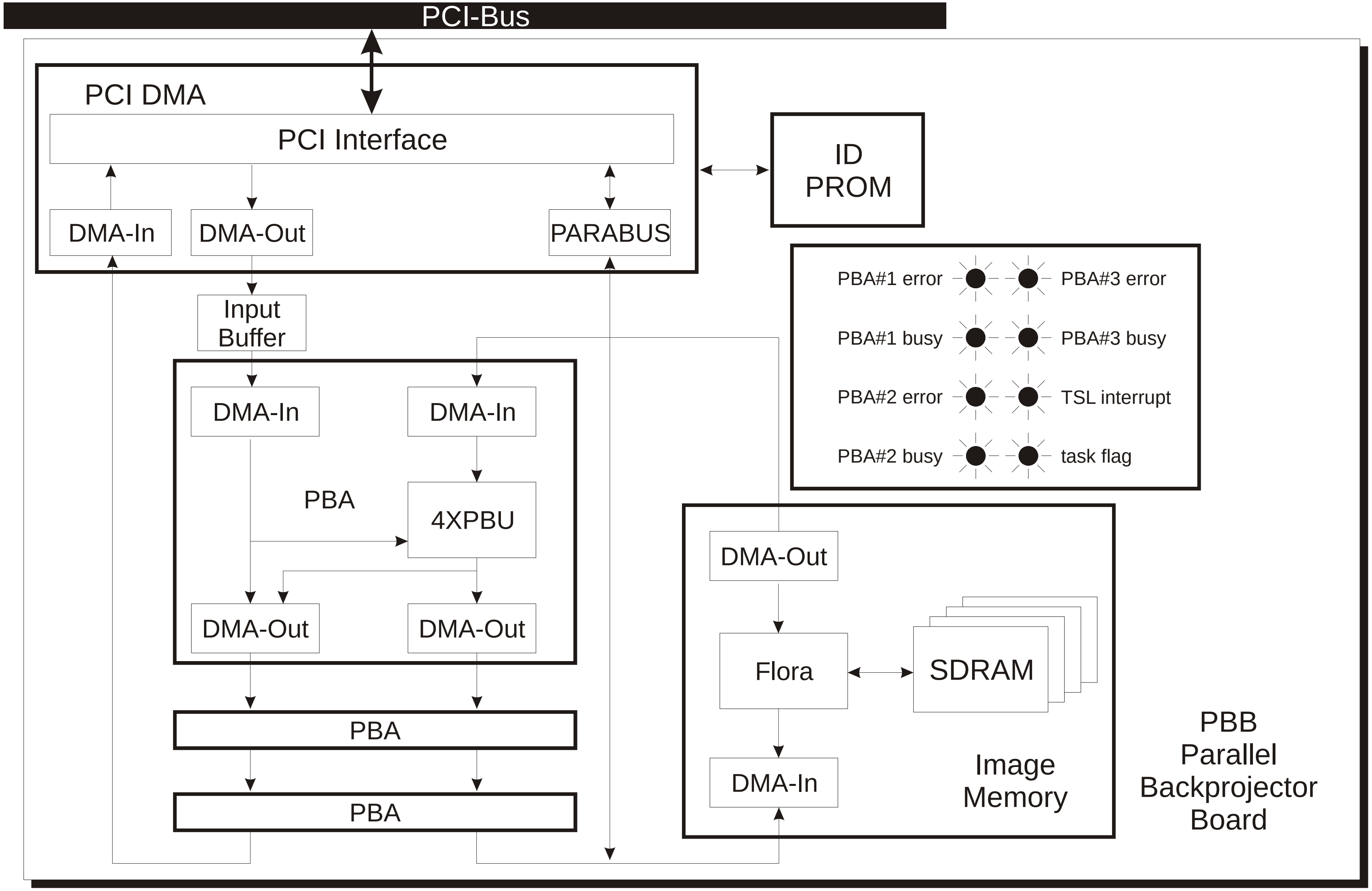

PCI-Bus
PCI DMA
PCI Interface
DMA-In
DMA-Out
PARABUS
ID PROM
PBA#1 error
PBA#3 error
PBA#1 busy
PBA#3 busy
PBA#2 error
TSL interrupt
PBA#2 busy
task flag
Input Buffer
DMA-In
DMA-In
PBA
4XPBU
DMA-Out
DMA-Out
PBA
PBA
DMA-Out
Flora
SDRAM
DMA-In
Image Memory
PBB Parallel Backprojector Board

Figure 2-32: Parallel Backprojector Board

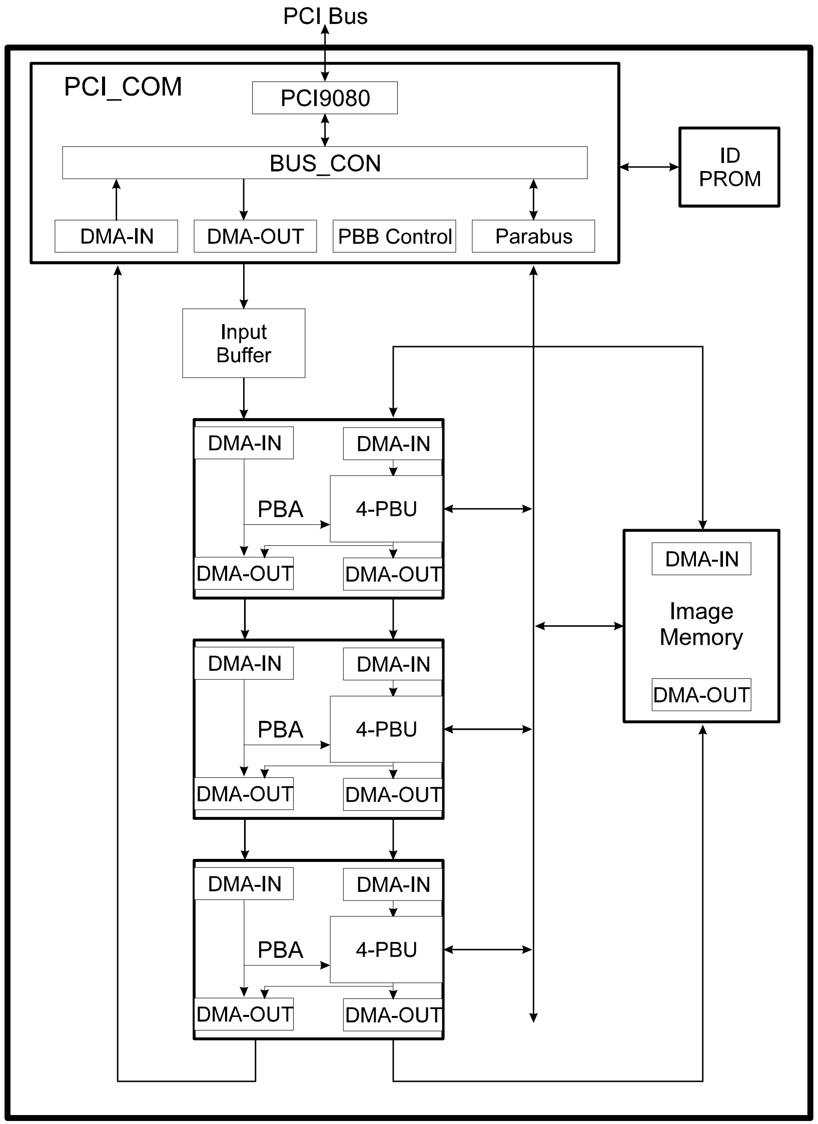

PCI Bus
PCI_COM
PCI9080
BUS_CON
ID
PROM
DMA-IN
DMA-OUT
PBB Control
Parabus
Input
Buffer
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
Image
Memory
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT

Figure 2-33: Structure of the Parallel Backprojector Board

Flora

The Flora has two DMA channels and supports one random access bus connected to the parabus, which is used for parameterizing and host access to the SDRAM.

PCI_CON (PCI Control) Board

The PCI_CON (PCI Control) card includes the PCI bus interface chip "PCI9060", the bus connection "BUS_CON" and the PBB Control.

PBB control includes the Input Buffer control, status registers, the task control, the DMA control and the error handling.

BUS_CON

The BUS_CON (bus connection) connects the PCI9060’s local bus to the parabus, the DMA input bus of the input buffer and to the PODI of the last BPA.

Input Buffer

PCPB_IN_BUF	Input Buffer
PCPB1_IN_BUF	Input Buffer
PCPB2_IN_BUF	Input Buffer

Specifications:

- Static RAM memory.
- Stores the incoming task sets (projection data + parameters) while the backprojection pipeline is operating.
- PBB Control loads task sets from the Input Buffer to the PBA(s).
- Load of a task set from the Input Buffer to the PC-PB3 is performed in less than 1.0 ms for a task set with 12 * 2K * 32 bit .
- RAM size: 32 K * 32 bit.
- Memory: write-and readable via the PCI9060’s local bus by random access.

Parallel Backprojector ASIC Pipeline

The Parallel Backprojector ASICs (PBA) include the arithmetic for the backprojection algorithm. Each PBA has four Parallel Backprojector Units (PBU), thus four projections can be accumulated to the image concurrently in each PBA, two projections in sum on the PC-PB3 board.

Specifications:

- Consists of three Parallel Backprojector ASICs (PBAs)
- Operates with 40 MHz clock frequency (maximum)
- A full backprojection cycle lasts less than 8 ms (including the backprojection of 12 projections to a 512 x 512 pixel image, the load of a 12 * 2k * 32 bit task set and the necessary handshake)

Image Memory

PCPB_IMAGE_MEM	Image Memory
PCPB1_IMAGE_MEM	Image Memory
PCPB2_IMAGE_MEM	Image Memory

Specifications:

- Image Memory stores the temporary image
- Consists of:
  - SDRAMs
  - The ASIC FLORA, which operates as an SDRAM-controller
- The FLORA has two DMA-channels
- The RAM size of the SDRAM is 1M * 64 bit

PBB Operating States

There are several operating states, in which the data paths of the PBB are routed differently. The operating states are as follows:

- IDLE
- LOAD TASK SET TO PBA
- PRESET IMAGE MEMORY
- BACKPROJECT/PROCESS IMAGE DATA
- PROCESS IMAGE DATA AND FEED THEM TO PCI BUS (see 3.2.5)[MC1]

These operating states are controlled by "Backprojector Functions", "Backprojector Tasks" and the task flag. "Backprojector Functions" are initiated via the Parabus, while "Backprojector Tasks" are loaded to the Input Buffer by PCI Bus DMAs.

PCPB_TASK_RECEIVE	Receive a task set
PCPB1_TASK_RECEIVE	Receive a task set
PCPB2_TASK_RECEIVE	Receive a task set

A new task set can be received from the IRS within the following operating states:

- IDLE state
- Preset Image Memory
- Backproject/Process image data
- Process data and feed them to PCI bus (PCI) slave (access only at DMA address space of input buffer) at local bus of PCI9060

After transferring a set of tasks to the Input Buffer of the PBB, the setting of the task flag initiates the loading of these tasks.

After the task set is loaded to the PBA(s), a PCI Bus interrupt is asserted and the task flag is reset to indicate that the Input Buffer can receive further tasks.

Idle State

After RESET, the board is in IDLE state. After a task set is processed completely, and no new task set is available in the Input Buffer, the board returns to the IDLE state. In the IDLE state, the Input Buffer can receive new tasks from the IRS.

See *Figure 2-34* for data paths in this state.

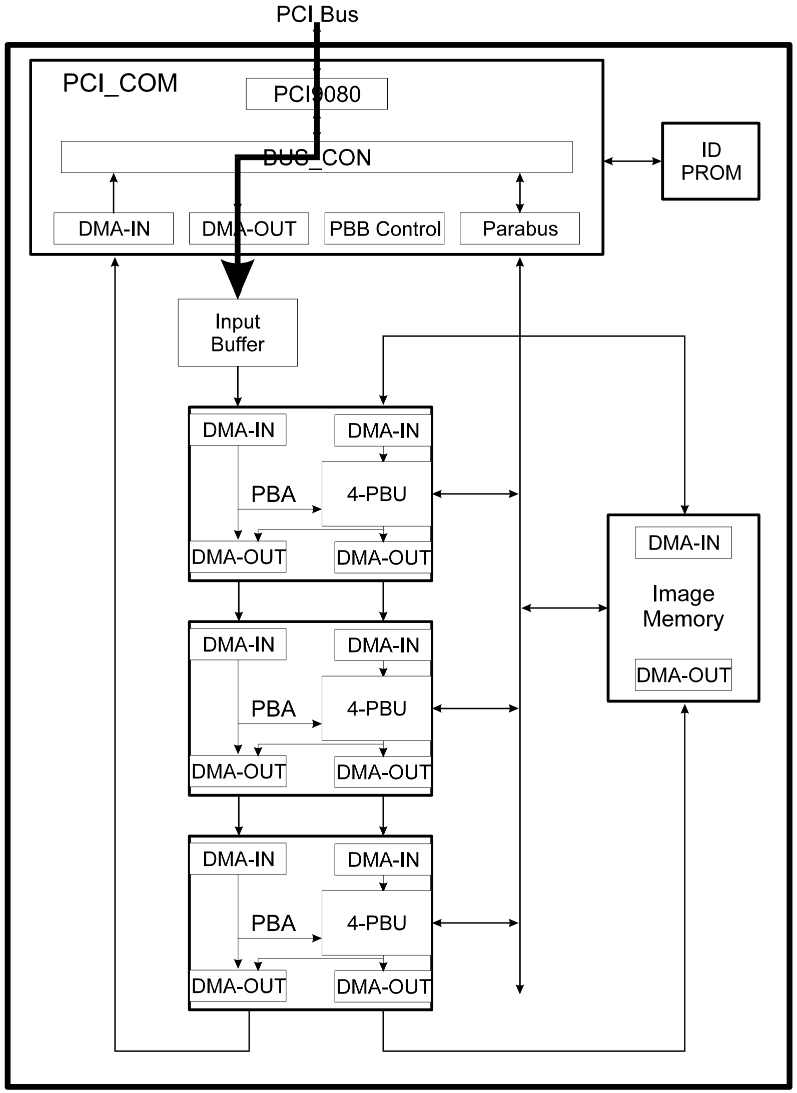

PCI Bus
PCI_COM
PCI9080
BUS_CON
DMA-IN
DMA-OUT
PBB Control
Parabus
ID PROM
Input Buffer
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
Image Memory
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT

Figure 2-34: Idle State, Data Paths

Load Task Set to PBA State

After the task flag is set by the control, and if no tasks are still running, the Input Buffer loads a task set to the PBAs.

The Input Buffer transfers the tasks to the first PBA of the pipeline. The PBAs distribute the tasks among themselves automatically if there is more than one PBA (PC-PB2 and PC-PB3).

After loading the task set, the PBAs start to operate automatically.

After loading the task set to the PBAs, the task flag is reset and an interrupt is asserted to the PCI bus by the PBB Control.

In the LOAD TASK SET TO PBA State, the Input Buffer cannot receive new tasks from the IRS.

See *Figure 2-35* for data paths in this state.

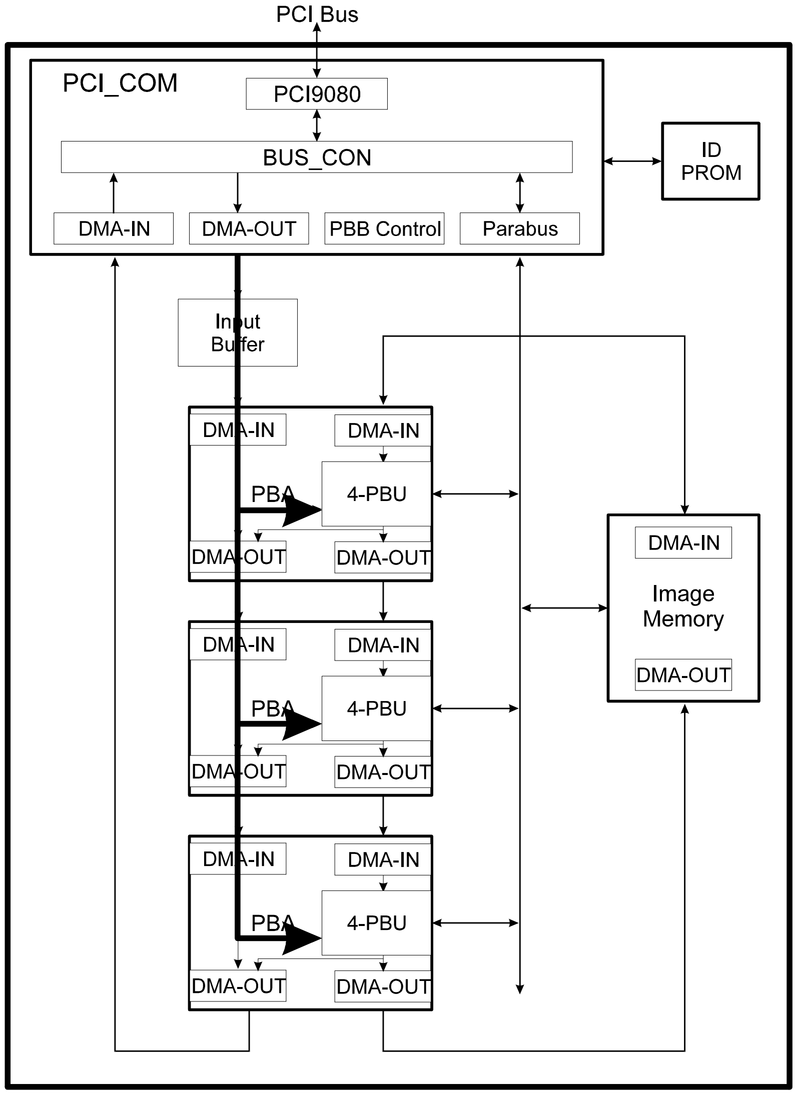

PCI Bus
PCI_COM
PCI9080
BUS_CON
DMA-IN
DMA-OUT
PBB Control
Parabus
ID PROM
Input Buffer
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
Image Memory
DMA-OUT

Figure 2-35: Load Task Set to PBA, Data Paths

Preset Image Memory State

Dummy data are read from the Image Memory, but not used.

Input data of the first PBU (in the first PBA of the pipeline) are preset to a value. Only the first PBA of the pipeline gets a preset task.

Processed data are written to the Image Memory.

In the PRESET IMAGE MEMORY state, the Input Buffer can receive new tasks from the IRS.

See *Figure 2-36* for data paths in this state.

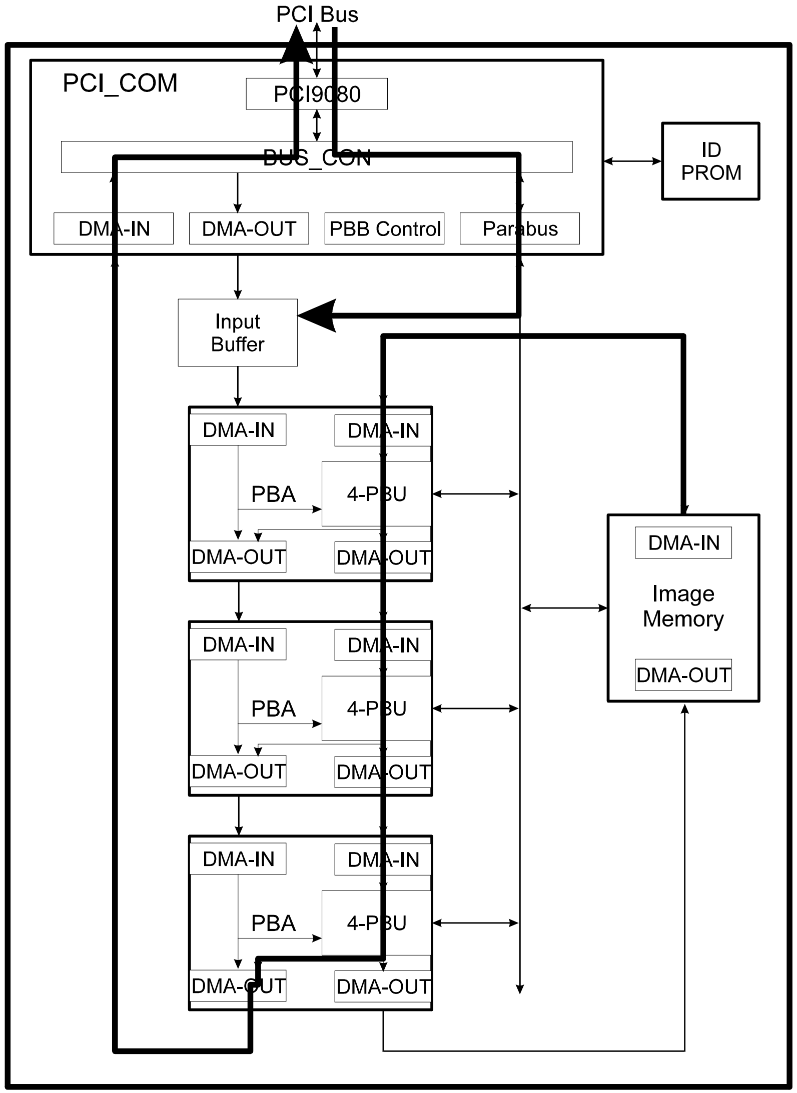

PCI Bus
PCI_COM
PCI9080
BUS_CON
DMA-IN
DMA-OUT
PBB Control
Parabus
ID PROM
Input Buffer
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
Image Memory
DMA-OUT

Figure 2-36: Preset Image Memory, Data Paths

Backproject/Process Image Data State

Image data are read from Image Memory.

PBA(s) process the image data (e.g., backproject, clip, etc.) or feed it through (short circuit).

Processed image data is written to Image Memory.

In the BACKPROJECT/PROCESS IMAGE DATA state, the Input Buffer can receive new tasks from the IRS.

See *Figure 2-37* for data paths in this state.

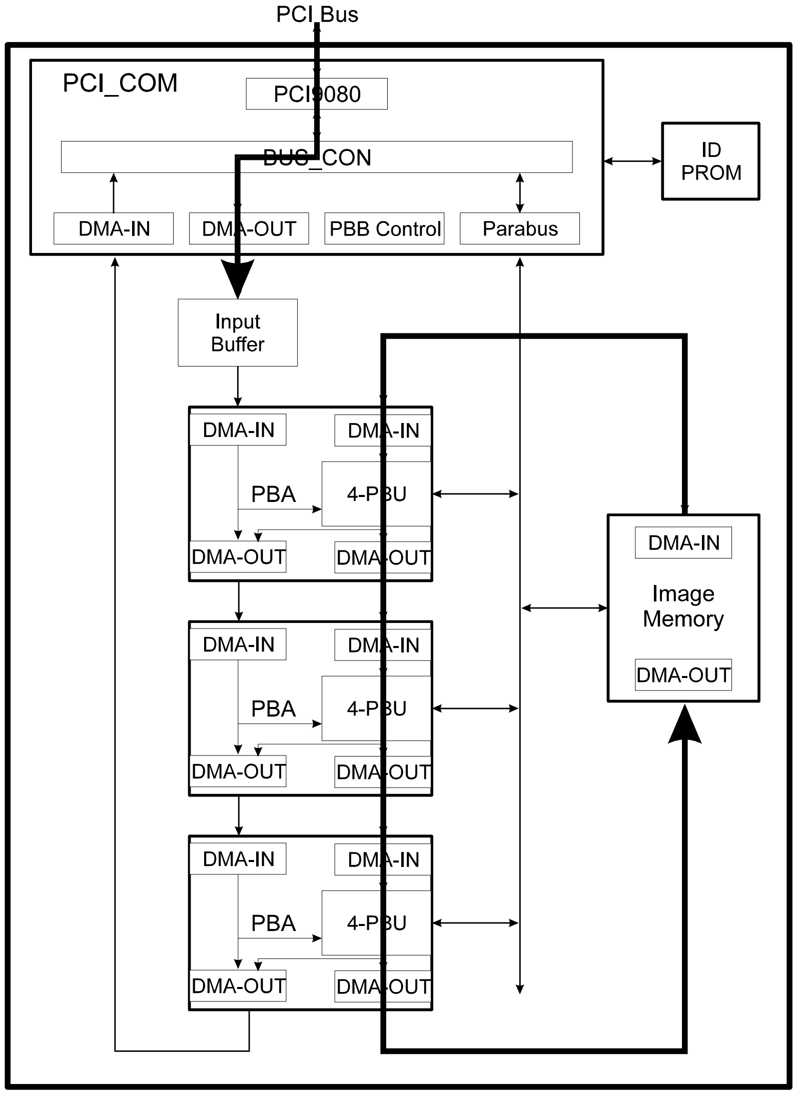

PCI Bus
PCI_COM
PCI9080
BUS_CON
ID
PROM
DMA-IN
DMA-OUT
PBB Control
Parabus
Input
Buffer
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
Image
Memory
DMA-OUT

Figure 2-37: Backproject/Process Image Data, Data Paths

Process Image Data and Feed Them to PCI Bus State

Image data are read out of the Image Memory.

The last PBA of the pipeline needs a read task.

Processed image data are fed to the PCI Bus (DMA).

Within, the PROCESS IMAGE DATA AND FEED THEM TO PCI BUS state, the Input Buffer can receive new tasks from the IRS only "per slave" access at the PCI-Bus (PCI9060, not DMA master).

Image data of the Image Memory are not modified.

See *Figure 2-38* for data paths in this state.

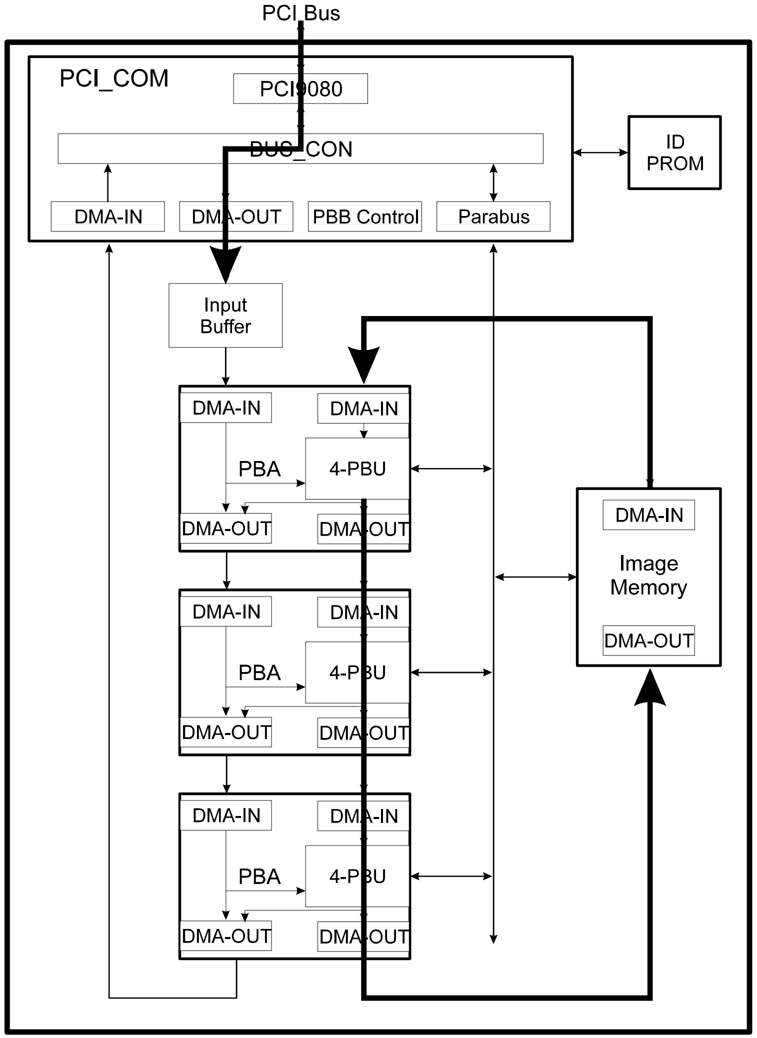

PCI Bus
PCI_COM
PCI9080
BUS_CON
DMA-IN
DMA-OUT
PBB Control
Parabus
ID
PROM
Input
Buffer
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
Image
Memory
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT
DMA-IN
DMA-IN
PBA
4-PBU
DMA-OUT
DMA-OUT

Figure 2-38: Process Image Data and Feed Them to PCI Bus, Data Paths

Diagnostics and Troubleshooting

IRS Troubleshooting

Preface

The purpose of this section is to provide the Service engineer with information needed to troubleshoot and solve IRS problems. Most IRS problems can be solved with the assistance of Diagnostics and other tools within the software. However, there is always the possibility that some problems will not be covered by this section. An understanding of the diagnostic tools will help in the resolution of these problems.

This document concentrates on IRS problems. Keep in mind that system problems may appear to be IRS-related when, in fact, they are not (e.g., ACQ errors caused by RCOM).

How the Section is Arranged

The section consists of the following three parts:

- IRS problems—divided into two scenarios
- IRS diagnostic supplement
- Commands and supplementary data

The document includes links to tests/commands to be executed, as well as references to page numbers for non-electronic users.

NOTE:

To troubleshoot an IRS problem, we recommend starting with a scenario describing the problem.

Safety Instructions

WARNING

ELECTROCUTION HAZARD!! IN THE EVENT THAT THE SOLUTION OF IRS PROBLEMS ENTAILS CARD REPLACEMENT:
- **SWITCH OFF ALL POWER TO THE IRS.**
- **SWITCH OFF POWER ON THE CT-BOX.**

FOLLOW THE SAFETY INSTRUCTIONS OUTLINED IN CHAPTER 1 OF THE MX8000 SERVICE MANUAL. FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

CAUTION

ALWAYS USE AN ESD PROTECTION WRIST STRAP WHEN SERVICING ANY COMPONENT IN THE SYSTEM.

Part 1

Scenarios of IRS Problems

Scenario #1

Scenario #1 deals with IRS problems that prevent the successful login into the Mx8000 application software. These problems are as follows:

- PCI errors
- Panics (Core Dumps)
- IRS server errors
- Reset Mercury time out
- IRS time out
- ACQ time out

Scenario #2

Scenario #2 deals with IRS problems that occur after logging into the Mx8000 application software. These problems are as follows:

- No reconstruction
- Partial reconstruction
- Image artifacts
- Resource allocation errors
- System failure to initialize

Stages for Obtaining a Successful Reconstruction

In a nominal working system, the logical steps *and* sequence to obtain a successful scan and reconstruction are as follows:

1. Individual configuration of IRS cards (*"Configmc Test" on page 2-100*)
2. Loading of software to all IRS cards (ResetMecury—included in *"Configmc Test" on page 2-100* and *"SCSI Test" on page 2-105*)
3. Communication between sharcs (*"Mercury Test" on page 2-103*)
4. Control of SCSI discs (*"SCSI Test" on page 2-105*)
5. Working ACQ (*"ACQ Tests" on page 2-116*)
6. Working Back projector (*"BPP Tests" on page 2-118*)
7. All of the above points working together (Reconstruction)

If one or more stages fail, there is no reconstruction.

Steps 1–6 can be performed using the nominal Diagnostics included in Mx8000 v2.2 (diagnostics icon). Perform each test independently of each other or in random order.

Step 7 uses the nominal off-line Reconstruction of Raw/Prep data.

IRS Configuration

There are two configurations of the IRS:

- 24 sharcs—standard for the Mx8000 Quad (optional for Mx8000 Dual)
- 16 sharcs—standard for the Mx8000 Dual

Table 2-3: 24 Sharcs Configuration

IRS MB SLOT	PC BOARD	"hinv" LOGICAL ADDRESS	COMMENTS
1	None		
2	Mercury System card	Bus 2, slot #6	
3	Acquisitor card	Bus 2, slot #7	
4	Bit3 PCI bridge card	Bus 1, slot #4	
5	Mercury Expansion 1 card	Bus 3, slot #4	RACEway->PCILK card
6	Mercury Expansion 2 card	Bus 3, slot #7	
7	BPP card	Bus 3, slot #6	
8	CIB card	Bus 3, slot #5	
	Bit3 PCI bridge card	Bus 2, slot #4	Resident on IRS MB
	Bit3 PCI bridge card	Bus 0, slot #3	Resident on the O2

Table 2-4: 16 Sharcs Configuration

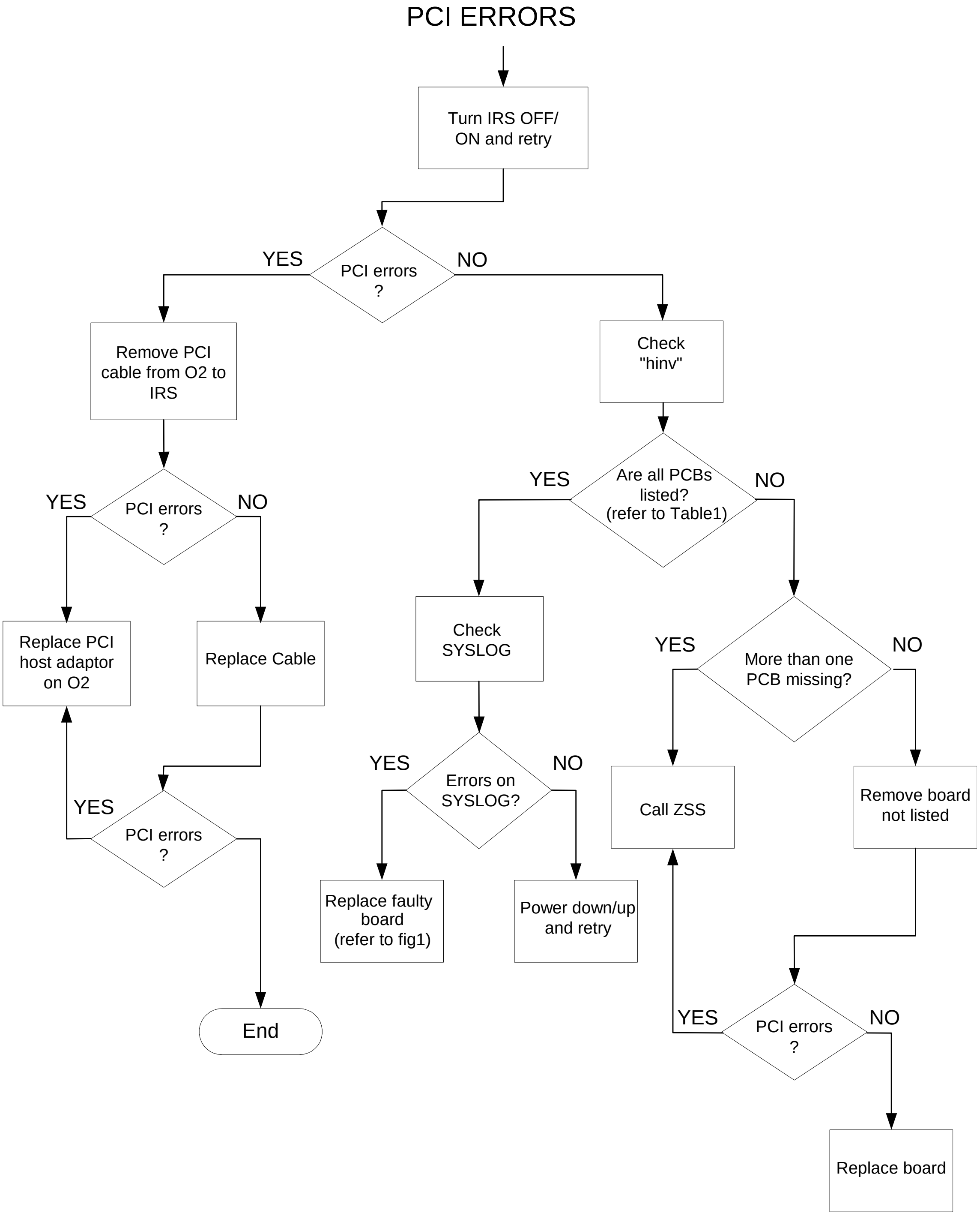
IRS MB SLOT	PC BOARD	"hinv" LOGICAL ADDRESS	COMMENTS
1	None		
2	Mercury System card	Bus 2, slot #6	
3	Acquisitor card	Bus 2, slot #7	
4	Bit3 PCI bridge card	Bus 1, slot #4	
5	Mercury Expansion 1 card	Bus 3, slot #4	
6	BPP card	Bus 3, slot #7	
7	None		
8	CIB card	Bus 3, slot #5	
	Bit3 PCI bridge card	Bus 2, slot #4	Resident on IRS MB
	Bit3 PCI bridge card	Bus 0, slot #3	Resident on the O2

Scenario #1

During boot up, the O2 senses the presence of four PCI buses and the card connected to them. The O2 looks for and verifies the configuration registers of each PCI card. If this operation fails, the system reports PCI errors, seen as a scrolling screen.

The following flowcharts describe the steps to troubleshoot the IRS errors.

PCI Errors


PCI ERRORS
Turn IRS OFF/ ON and retry
PCI errors ?
YES
NO
Remove PCI cable from O2 to IRS
PCI errors ?
YES
NO
Replace PCI host adaptor on O2
Replace Cable
PCI errors ?
YES
End
Check "hinv"
Are all PCBs listed? (refer to Table1)
YES
NO
Check SYSLOG
Errors on SYSLOG?
YES
NO
Replace faulty board (refer to fig1)
Power down/up and retry
More than one PCB missing?
YES
NO
Call ZSS
Remove board not listed
PCI errors ?
YES
NO
Replace board

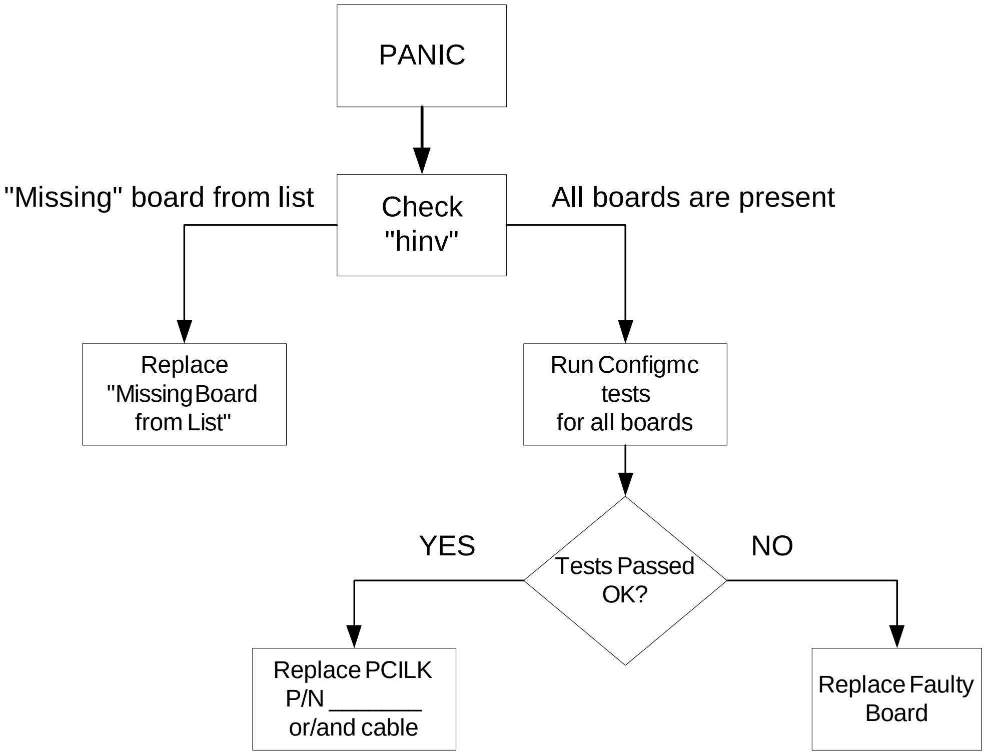
"The “hinv” Command" on page 2-120

"The SYSLOG File" on page 2-122

Panics

Panics or Core Dumps are a result of a failure of the system to load software to the Mercury cards and at the same time to reset the ACQ and BPP cards. This occurs during a ResetMercury command when loading the Mx8000 application software.

> **NOTE:**
>
> A ResetMercury command is issued either when logging into the Mx8000 application software, or when logging into Service, or when running the diagnostic (except for configmc).


PANIC
Check "hinv"
"Missing" board from list
All boards are present
Replace "Missing Board from List"
Run Configmc tests for all boards
Tests Passed OK?
YES
NO
Replace PCILK P/N _______ or/and cable
Replace Faulty Board

Verify that the O2 Computer main memory is 1024 Mb (see *page 2-120*). If this is not the memory size, a Panic may occur.

NOTE: FIX THE MEMORY PROBLEM AND CHECK FOR PANIC.

Verify that the O2 Computer main memory is the source for Panic as follows:

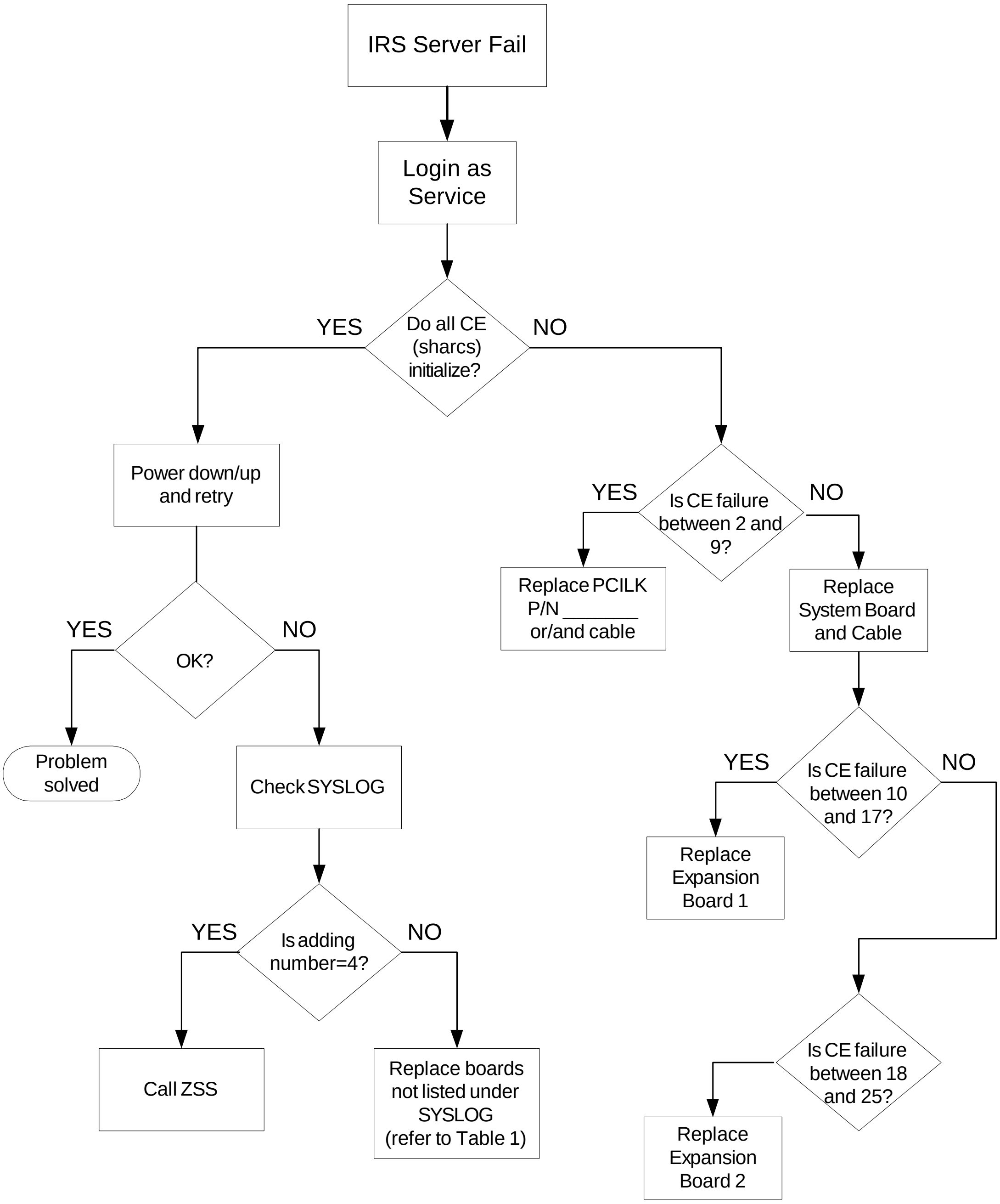
1. Turn the IRS and the O2 computer OFF, then turn O2 ON.
2. If a Panic occurs, check the O2 computer memory.
3. If a Panic does not occur, return to the flowchart.

"The “hinv” Command" on page 2-120

"Configmc Test" on page 2-100

IRS Server Fail

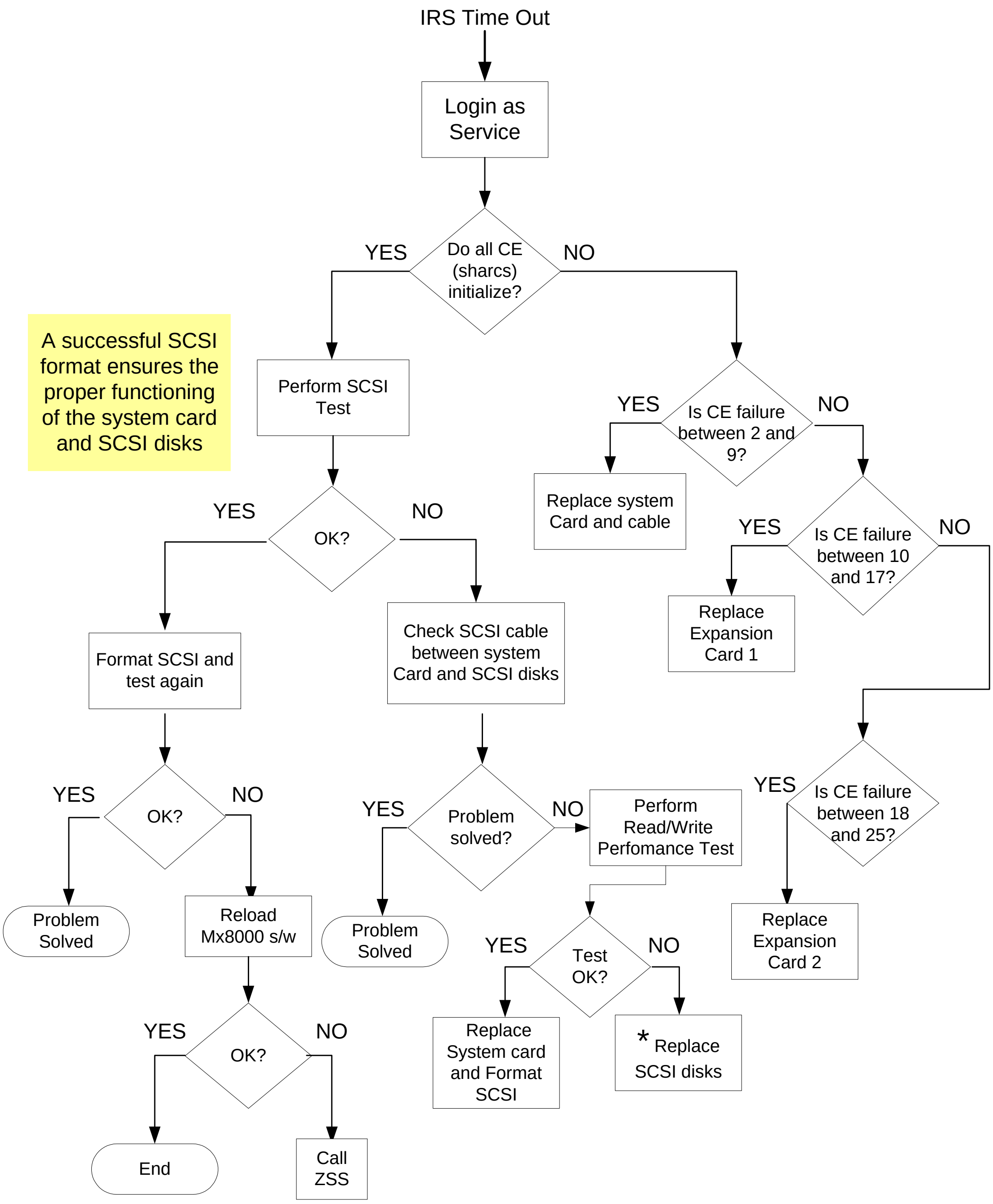
This problem is seen at Login as a red box on the screen.


IRS Server Fail
Login as Service
Do all CE (sharcs) initialize?
YES
NO
Power down/up and retry
OK?
YES
NO
Problem solved
Check SYSLOG
Is adding number=4?
YES
NO
Call ZSS
Replace boards not listed under SYSLOG (refer to Table 1)
Is CE failure between 2 and 9?
YES
NO
Replace PCILK P/N _______ or/and cable
Replace System Board and Cable
Is CE failure between 10 and 17?
YES
NO
Replace Expansion Board 1
Is CE failure between 18 and 25?
Replace Expansion Board 2

"The SYSLOG File" on page 2-122

IRS Time Out

System fails to connect to the IRS.

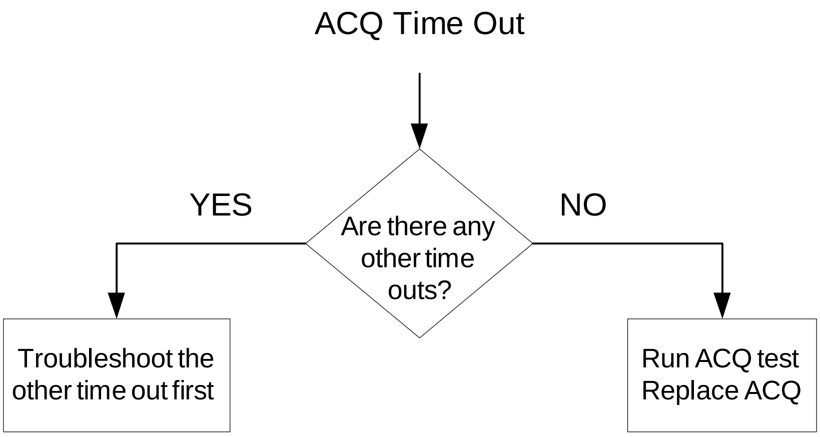

IRS Time Out
Login as Service
Do all CE (sharcs) initialize?
YES
NO
A successful SCSI format ensures the proper functioning of the system card and SCSI disks
Perform SCSI Test
Is CE failure between 2 and 9?
YES
NO
Replace system Card and cable
Is CE failure between 10 and 17?
YES
NO
Replace Expansion Card 1
OK?
YES
NO
Format SCSI and test again
Check SCSI cable between system Card and SCSI disks
OK?
YES
NO
Problem Solved
Reload Mx8000 s/w
Problem solved?
YES
NO
Problem Solved
Perform Read/Write Perfomance Test
Is CE failure between 18 and 25?
YES
Replace Expansion Card 2
Test OK?
YES
NO
Replace System card and Format SCSI
* Replace SCSI disks
OK?
YES
NO
End
Call ZSS

* You must repeat SCSI disk format after you replace SCSI disks.

"SCSI Test" on page 2-105

ACQ Time Out

During login to Mx8000


ACQ Time Out
Are there any other time outs?
YES
NO
Troubleshoot the other time out first
Run ACQ test
Replace ACQ

"ACQ Tests" on page 2-116

"Configmc Test" on page 2-100

"DMC Test" on page 2-101

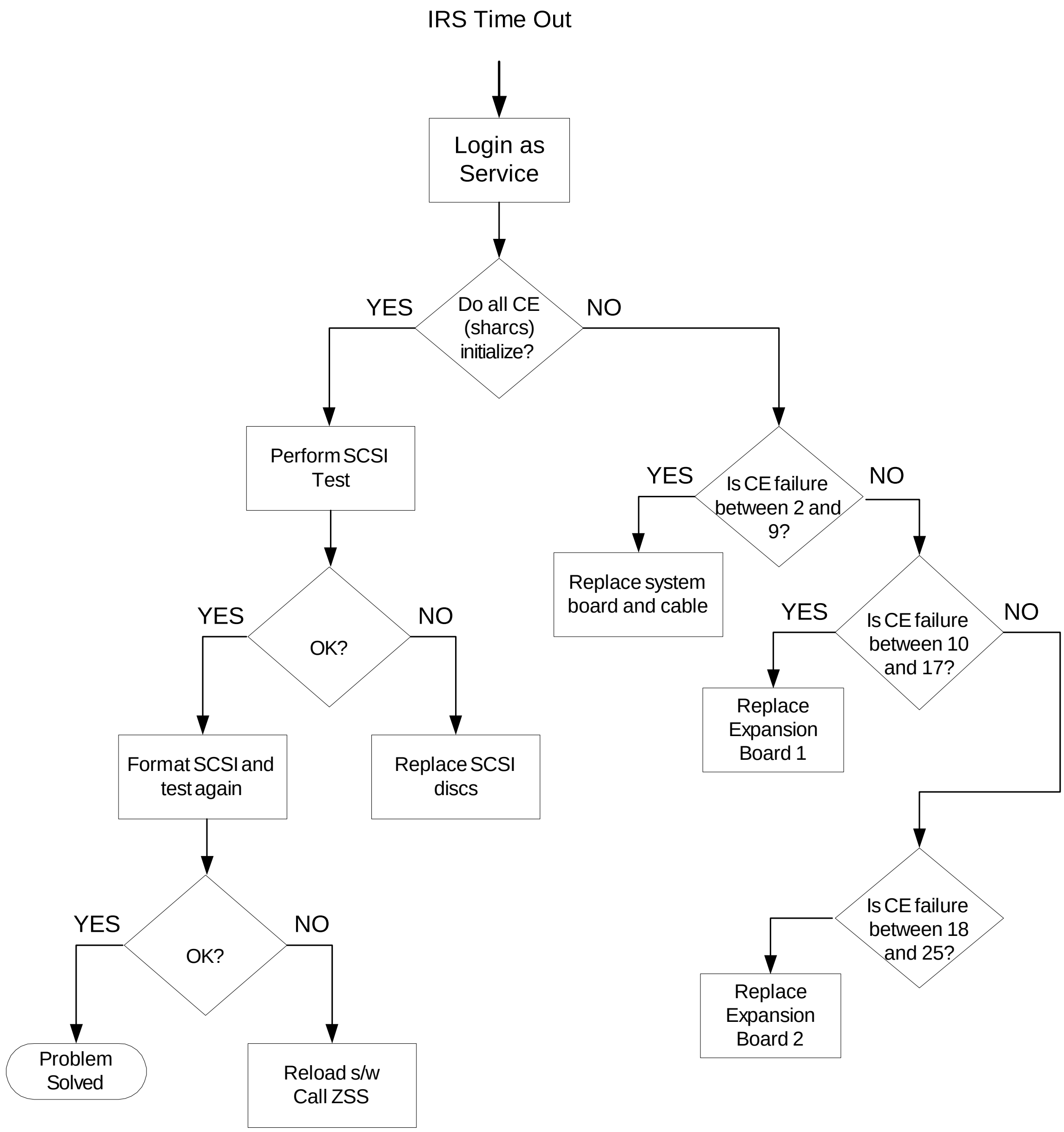
"Mercury Test" on page 2-103

"SCSI Test" on page 2-105

Scenario #2

This scenario describes the possible cases where the system performed the scan, but there was either no reconstruction or partial reconstruction.

No Reconstruction


IRS Time Out
Login as Service
Do all CE (sharcs) initialize?
YES
NO
Perform SCSI Test
OK?
YES
NO
Format SCSI and test again
Replace SCSI discs
OK?
YES
NO
Problem Solved
Reload s/w Call ZSS
Is CE failure between 2 and 9?
YES
NO
Replace system board and cable
Is CE failure between 10 and 17?
YES
NO
Replace Expansion Board 1
Is CE failure between 18 and 25?
Replace Expansion Board 2

"BPP Tests" on page 2-118

"ps24 Command" on page 2-129

"irsmon Command" on page 2-144

STEP	ACTION	YES	NO
1	IRS errors in ERRLOG?	Proceed to Step 2	Check error and repair (e.g, MCU 00 00 54 see Communication Data Path Troubleshooting P/N 491-7181-4607)
2	Bad CEs Messages?	Replace card according to message	Proceed to Step 3
3	• Format SCSI • Login and repeat scan		

Tips

- Try to reconstruct the Raw/Prep data without Image Balance and Phantom Calibrations. If reconstruction can be performed and completed, perform SCSI format.
- In rare cases, all tests finish without errors, but no image is displayed on the screen. Swap 1st Expansion and 2nd Expansion cards and repeat scan.

  Two possible scenarios may occur:

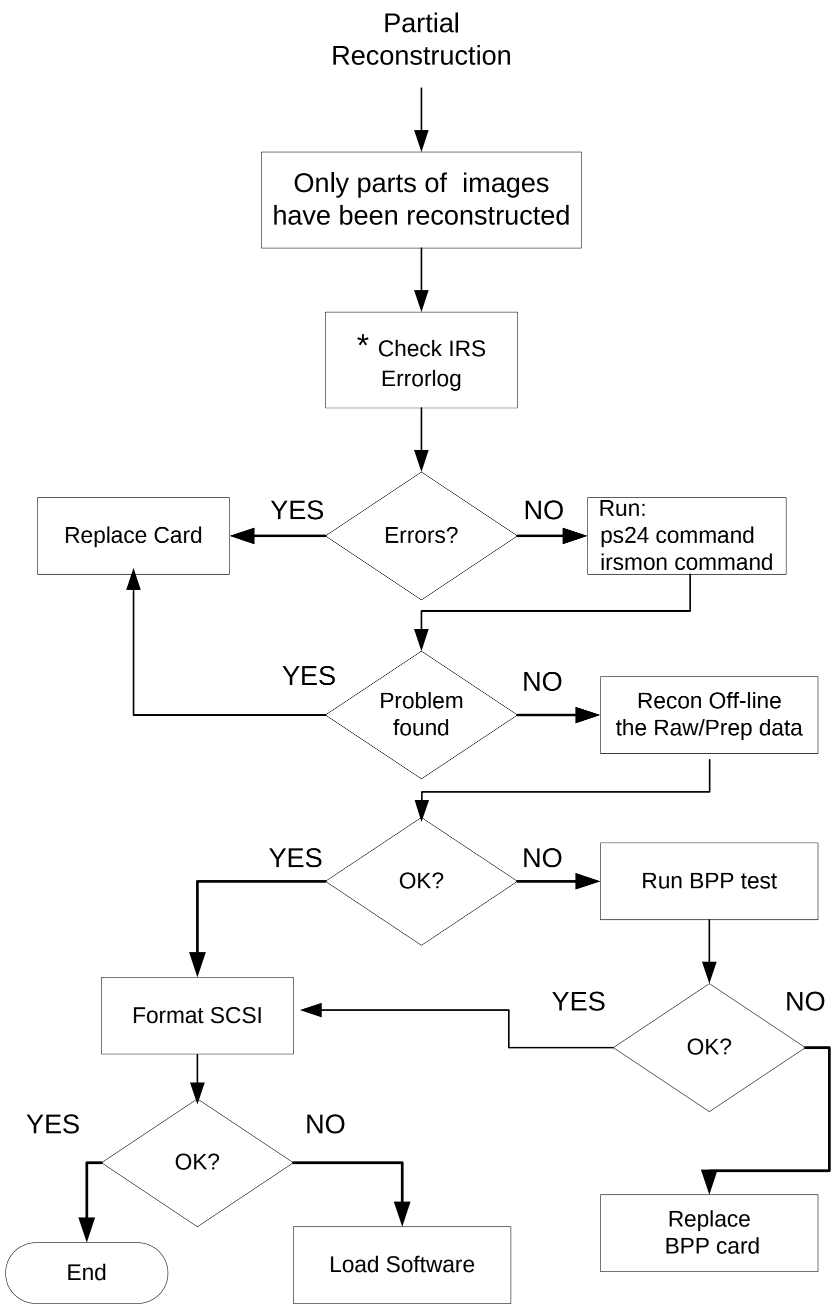
  — A scan is performed and all reconstructed images are displayed without any errors. Check all scan modes, and observe the system for irregularities. If the problem does not occur, leave the Expansion cards as they are.

  — A different phenomenon error occurs. Analyze the new fault and act accordingly.

NOTE:

Set all parameters to default after fixing the problem.

Partial Reconstruction


Partial Reconstruction
Only parts of images have been reconstructed
* Check IRS Errorlog
Errors?
YES
Replace Card
NO
Run:
ps24 command
irsmon command
Problem found
YES
NO
Recon Off-line the Raw/Prep data
OK?
YES
NO
Run BPP test
Format SCSI
OK?
YES
NO
Replace BPP card
OK?
YES
NO
End
Load Software

* The IRS Errorlog is at **Service|Procmon**

TIP — Try to reconstruct the Raw/Prep data without Image Balance and Phantom Calibrations.
If reconstruction can be performed and completed, perform SCSI format.

"BPP Tests" on page 2-118

"ps24 Command" on page 2-129

"irsmon Command" on page 2-144

Image Artifacts

There are image artifacts from sources other than the DMS.

This section is for cases where no problem was found in the DMS.

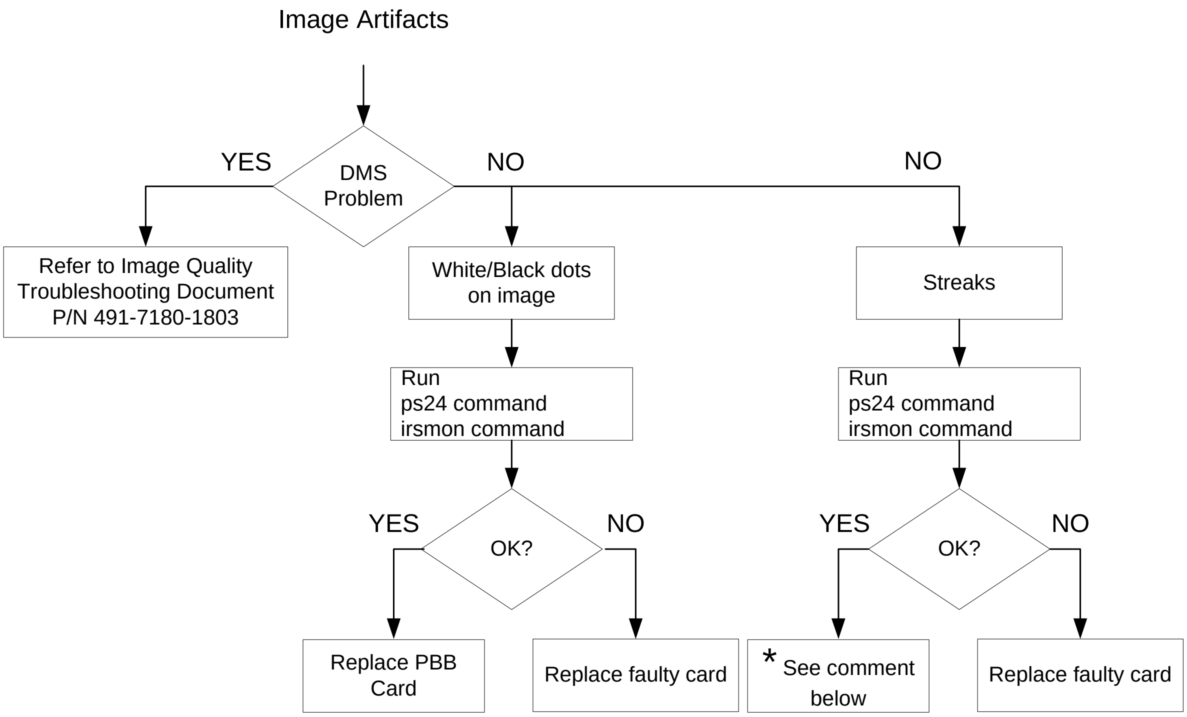


Image Artifacts
DMS Problem
YES
NO
NO
Refer to Image Quality Troubleshooting Document P/N 491-7180-1803
White/Black dots on image
Streaks
Run ps24 command irsmon command
Run ps24 command irsmon command
YES
OK?
NO
YES
OK?
NO
Replace PBB Card
Replace faulty card
* See comment below
Replace faulty card

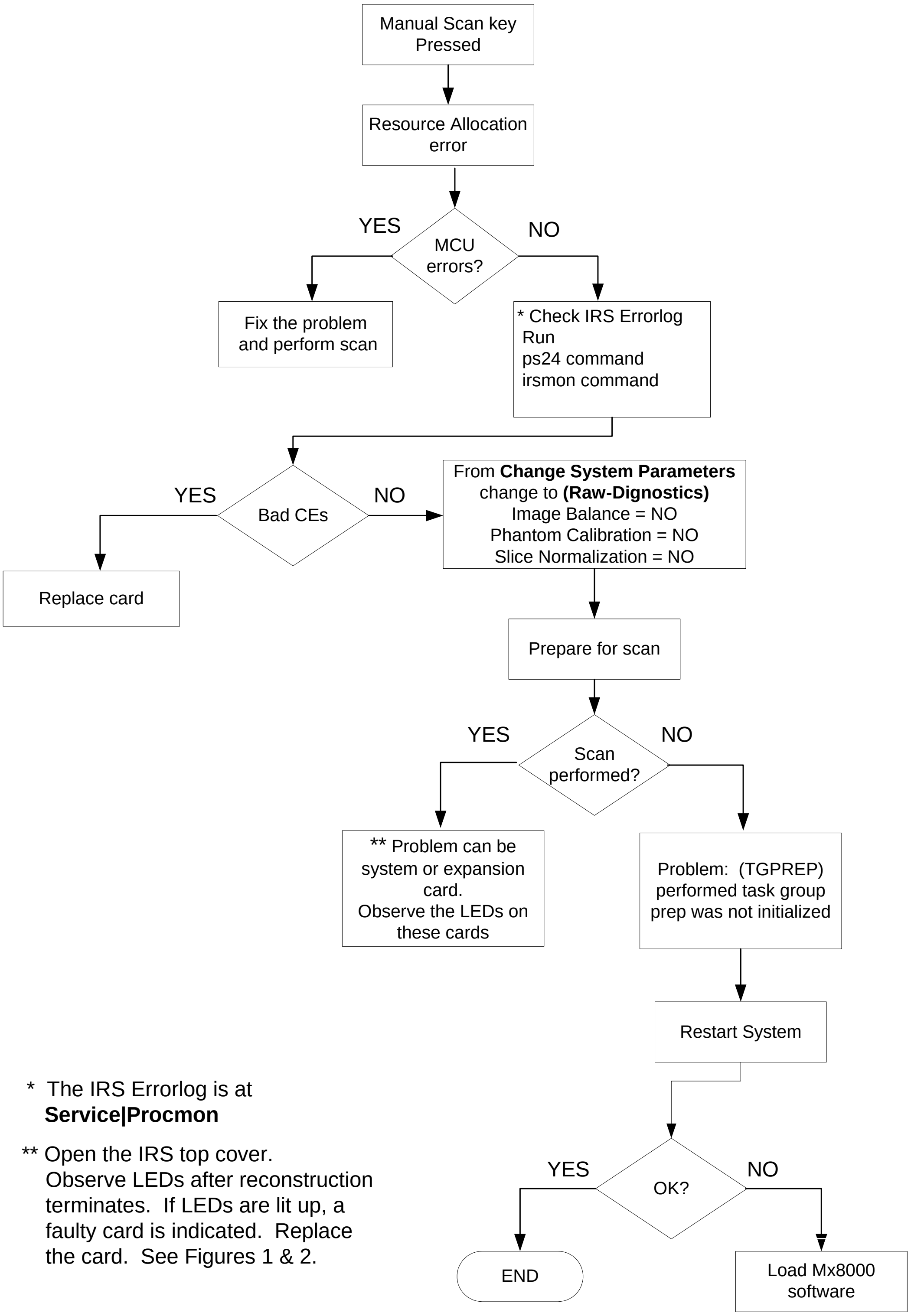
* There is a possibility that all the relevant tests will pass and, when reconstruction is repeated, streaks will not be evident.
The possible cause for this problem could be the expansion and system cards.
Because the problem is intermittent, it is worthwhile to delay repair until there is a "real" failure.

"ps24 Command" on page 2-129

"irsmon Command" on page 2-144

Resource Allocation Errors

The "Resource Allocation Error" may appear when the system is ready for scan and the **Manual Scan** key is pressed.


Manual Scan key Pressed
Resource Allocation error
MCU errors?
YES
NO
Fix the problem and perform scan
* Check IRS Errorlog
Run
ps24 command
irsmon command
Bad CEs
YES
NO
Replace card
From **Change System Parameters** change to **(Raw-Dignostics)**
Image Balance = NO
Phantom Calibration = NO
Slice Normalization = NO
Prepare for scan
Scan performed?
YES
NO
** Problem can be system or expansion card.
Observe the LEDs on these cards
Problem: (TGPREP) performed task group prep was not initialized
Restart System
OK?
YES
NO
END
Load Mx8000 software

* The IRS Errorlog is at **Service|Procmon**

** Open the IRS top cover. Observe LEDs after reconstruction terminates. If LEDs are lit up, a faulty card is indicated. Replace the card. See Figures 1 & 2.

"ps24 Command" on page 2-129

"irsmon Command" on page 2-144

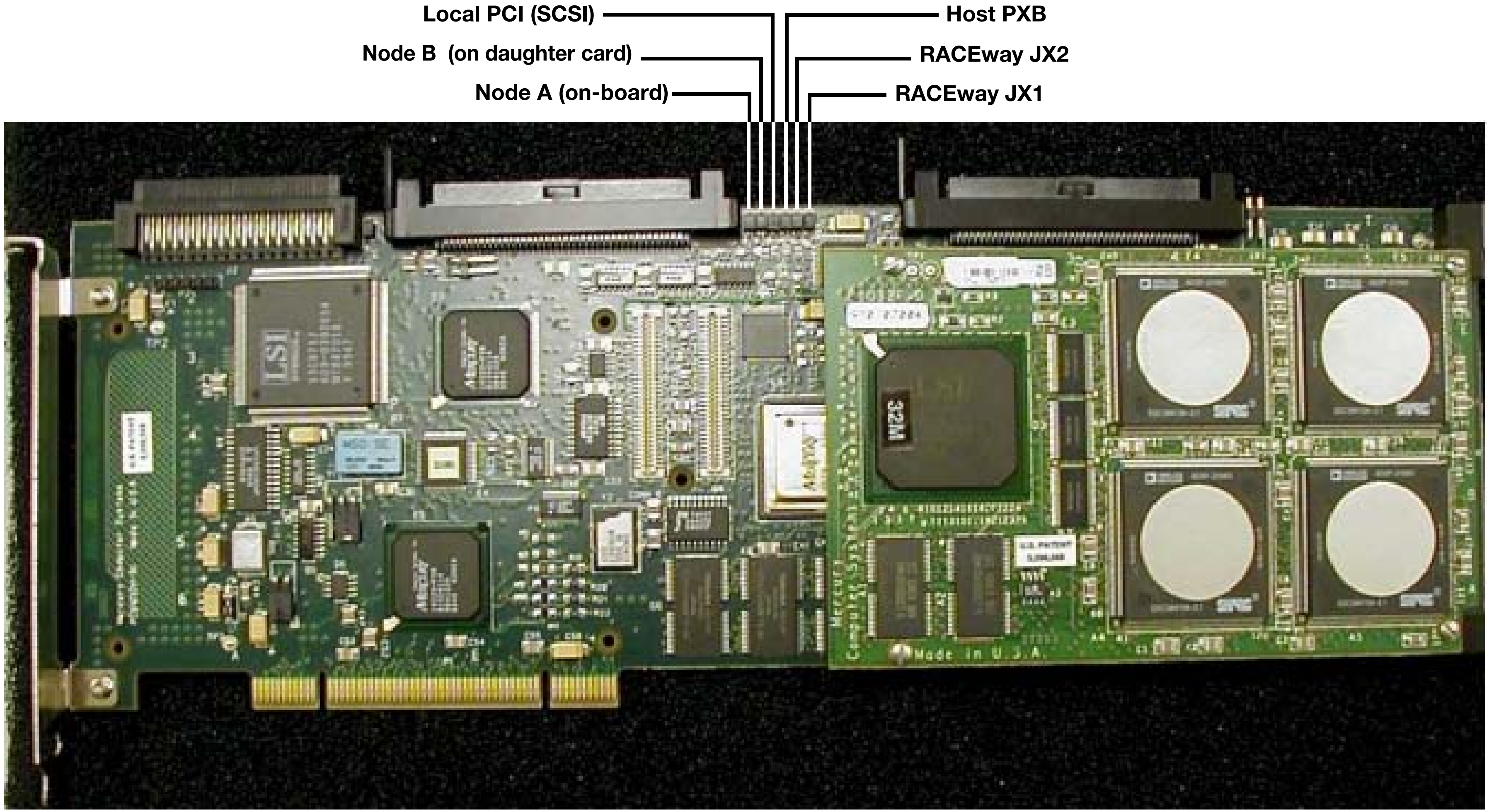

Local PCI (SCSI)
Node B (on daughter card)
Node A (on-board)
Host PXB
RACEway JX2
RACEway JX1

Figure 2-39: LEDs on Mercury System Card

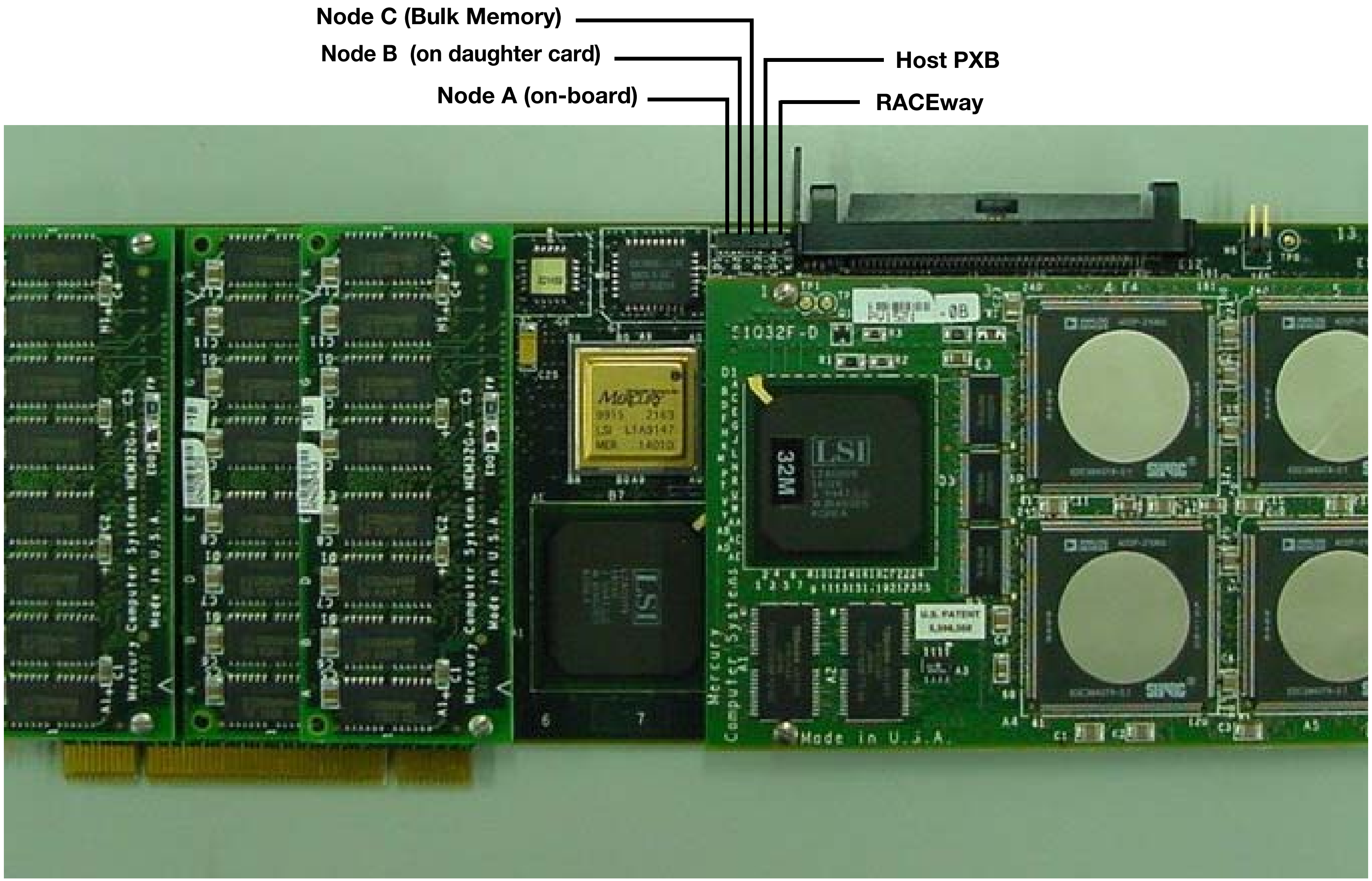

Node C (Bulk Memory)
Node B (on daughter card)
Node A (on-board)
Host PXB
RACEway

Figure 2-40: LEDS on Mercury Expansion Card

System Failure to Initialize

This occurs when the system never gets to ready state. Proceed as follows:

1. Check Errorlog Viewer for errors and check CanPro file error (if available). If there are non-IRS errors, fix them first and retry.
2. Check the IRS Errorlog at **Service|Procmon**.

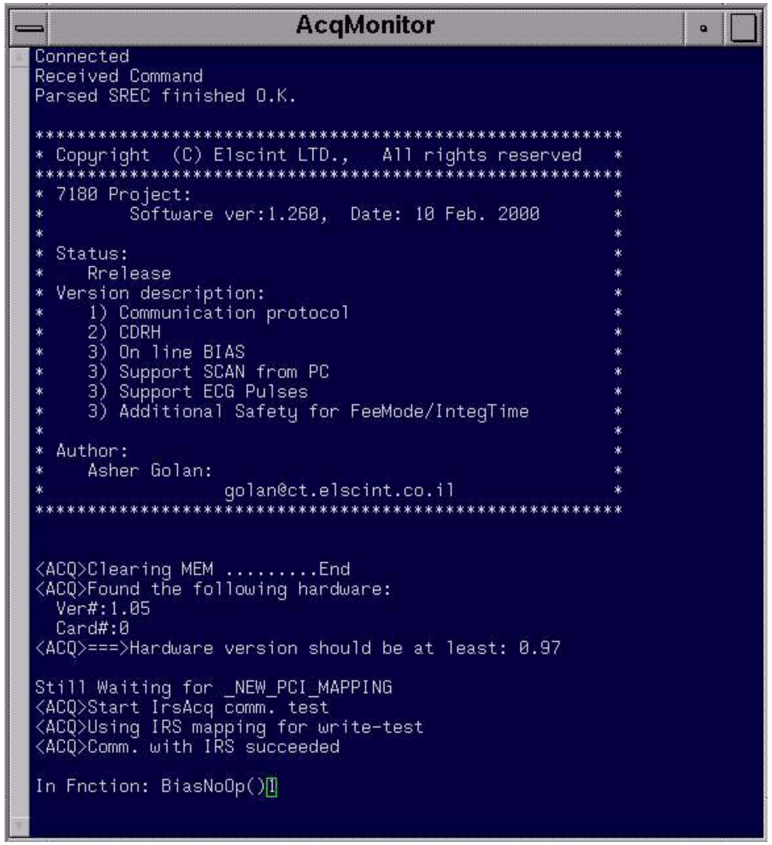
NOTE:

Expect to see ACQ RISC errors. Do the following:

1. Open the IRS Errorlog window at **Service | Procmon** and expect to see the following **error:**

   <ACQ> Still Waiting to RISC getting into READY state machine.

   The problem can be a defective or disconnected fiber-optic cable.
2. Open the ACQ Monitor window at **Service | Procmon** (see *Figure 2-41*) and expect to see numbers advancing at the bottom of the window.
3. Go to **Diagnostics** and run the ACQ test.



```
Connected
Received Command
Parsed SREC finished O.K.

********************************************************
* Copyright  (C) Elscint LTD.,   All rights reserved   *
********************************************************
* 7180 Project:                                        *
*        Software ver:1.260,  Date: 10 Feb. 2000       *
*                                                      *
* Status:                                              *
*    Rrelease                                          *
* Version description:                                 *
*    1) Communication protocol                         *
*    2) CDRH                                           *
*    3) On line BIAS                                   *
*    3) Support SCAN from PC                           *
*    3) Support ECG Pulses                             *
*    3) Additional Safety for FeeMode/IntegTime        *
*                                                      *
* Author:                                              *
*    Asher Golan:                                      *
*                 golan@ct.elscint.co.il               *
********************************************************


<ACQ>Clearing MEM .........End
<ACQ>Found the following hardware:
  Ver#:1.05
  Card#:0
<ACQ>===>Hardware version should be at least: 0.97

Still Waiting for _NEW_PCI_MAPPING
<ACQ>Start IrsAcq comm. test
<ACQ>Using IRS mapping for write-test
<ACQ>Comm. with IRS succeeded

In Fnction: BiasNoOp()1
```

Figure 2-41: ACQ Monitor Window

Part 2

IRS Diagnostic Supplement

This section provides information regarding the nominal IRS diagnostics of Mx8000 v2.2.

IRS diagnostics is enabled with the use of a “diagnostic” key (second key). Access to the diagnostics requires a valid license key.

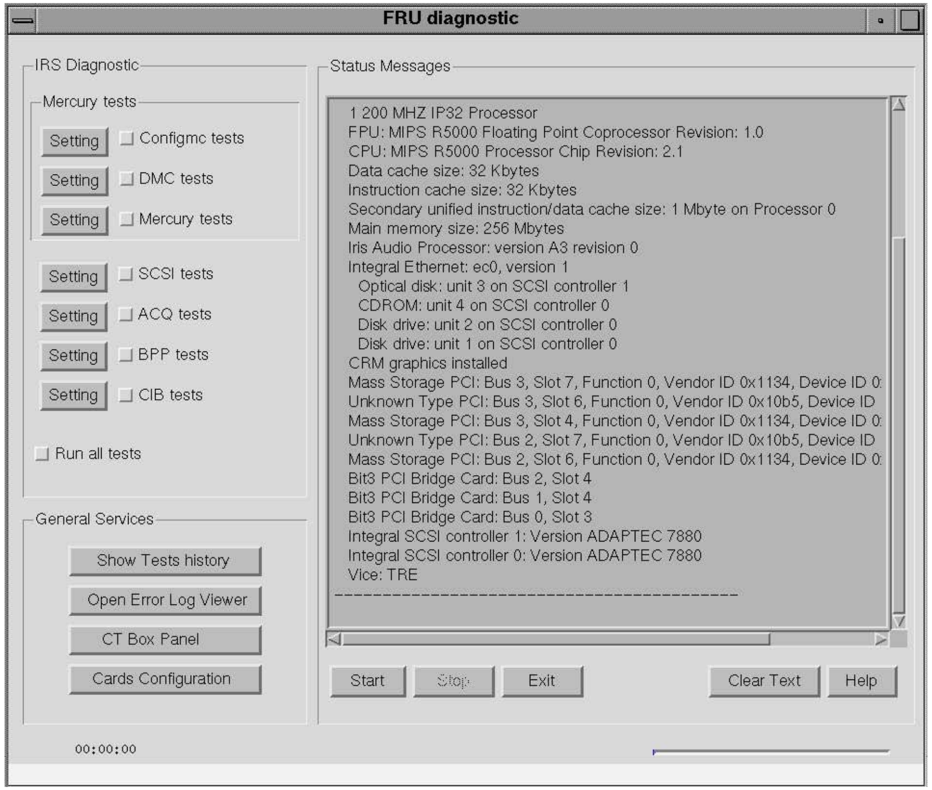
Installation of a License Key

1. Login as **root** (password **pkserv99**).
2. Type: **cd /usr/diamond.root/diagnostic** and press **<enter>.**
3. Type: **./installkey** and press **<enter>**
4. Enter the 32 hexadecimal digits and the 4-digit check sum number from the printout according to your system S/N.

Diagnostics Operation

From the Icon menu, select the **Diagnostic** icon (double-click) and enter the password: **service_**

The **FRU diagnostic** menu opens (see *Figure 2-42*). The FRU diagnostic menu includes tests to be performed, displays card configuration and the system’s **hinv**.


FRU diagnostic
IRS Diagnostic
Mercury tests
Setting ☐ Configmc tests
Setting ☐ DMC tests
Setting ☐ Mercury tests
Setting ☐ SCSI tests
Setting ☐ ACQ tests
Setting ☐ BPP tests
Setting ☐ CIB tests
☐ Run all tests
General Services
Show Tests history
Open Error Log Viewer
CT Box Panel
Cards Configuration
Status Messages
Start
Stop
Exit
Clear Text
Help
00:00:00

```
 1 200 MHZ IP32 Processor
FPU: MIPS R5000 Floating Point Coprocessor Revision: 1.0
CPU: MIPS R5000 Processor Chip Revision: 2.1
Data cache size: 32 Kbytes
Instruction cache size: 32 Kbytes
Secondary unified instruction/data cache size: 1 Mbyte on Processor 0
Main memory size: 256 Mbytes
Iris Audio Processor: version A3 revision 0
Integral Ethernet: ec0, version 1
  Optical disk: unit 3 on SCSI controller 1
  CDROM: unit 4 on SCSI controller 0
  Disk drive: unit 2 on SCSI controller 0
  Disk drive: unit 1 on SCSI controller 0
CRM graphics installed
Mass Storage PCI: Bus 3, Slot 7, Function 0, Vendor ID 0x1134, Device ID 0:
Unknown Type PCI: Bus 3, Slot 6, Function 0, Vendor ID 0x10b5, Device ID
Mass Storage PCI: Bus 3, Slot 4, Function 0, Vendor ID 0x1134, Device ID 0:
Unknown Type PCI: Bus 2, Slot 7, Function 0, Vendor ID 0x10b5, Device ID
Mass Storage PCI: Bus 2, Slot 6, Function 0, Vendor ID 0x1134, Device ID 0:
Bit3 PCI Bridge Card: Bus 2, Slot 4
Bit3 PCI Bridge Card: Bus 1, Slot 4
Bit3 PCI Bridge Card: Bus 0, Slot 3
Integral SCSI controller 1: Version ADAPTEC 7880
Integral SCSI controller 0: Version ADAPTEC 7880
Vice: TRE
-------------------------------------------
```

Figure 2-42: FRU Diagnostic Menu

NOTE:

The tests in the FRU diagnostic menu can be performed in random order or in sequence (performed by selecting **Run all tests**). To troubleshoot a specific problem (e.g., a Panic problem), it is recommended to start with the **Configmc tests**.

NOTE:

A selected test or configuration appears in yellow.

NOTE:

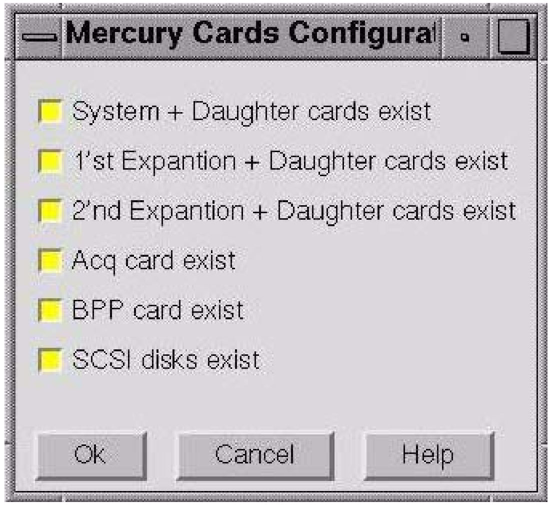
When attempting to activate a test from the FRU diagnostic menu, the system may appear frozen. Press **Alt + Tab**. A hidden window may appear. Close this window to reactivate the FRU diagnostic menu.

Setting Up for Testing

Tests can run on a maximum (nominal) card configuration or any configuration for troubleshooting.

To set the Mercury Cards Configeration, click **Cards Configuration** on the FRU Diagnostic Menu (see *Figure 2-42*).

Figure 2-43 displays the Mercury Cards Configuration Setting window. In this figure all cards and the SCSI disk are selected.



☑ System + Daughter cards exist
☑ 1'st Expantion + Daughter cards exist
☑ 2'nd Expantion + Daughter cards exist
☑ Acq card exist
☑ BPP card exist
☑ SCSI disks exist

Click to Highlight

*See Caution

Figure 2-43: Mercury Cards Configuration Setting Window

CAUTION

* FOR Mx8000 DUAL SYSTEMS WITH ONE EXPANSION CARD, DO NOT SELECT "2'ND EXPANSION + DAUGHTER CARDS EXIST". IF SELECTED, A "PANIC" SITUATION OCCURS.

NOTE:

All relevant results appear in the Diagnostic dialog box. Ignore the background window during the IRS diagnostic stages.

Configmc Test

The test performs initialization (resets the CEs) and configuration of selected parts in the IRS (see *Figure 2-44*). The operating system software is loaded to each IRS card separately (unlike in the nominal v2.2 software).

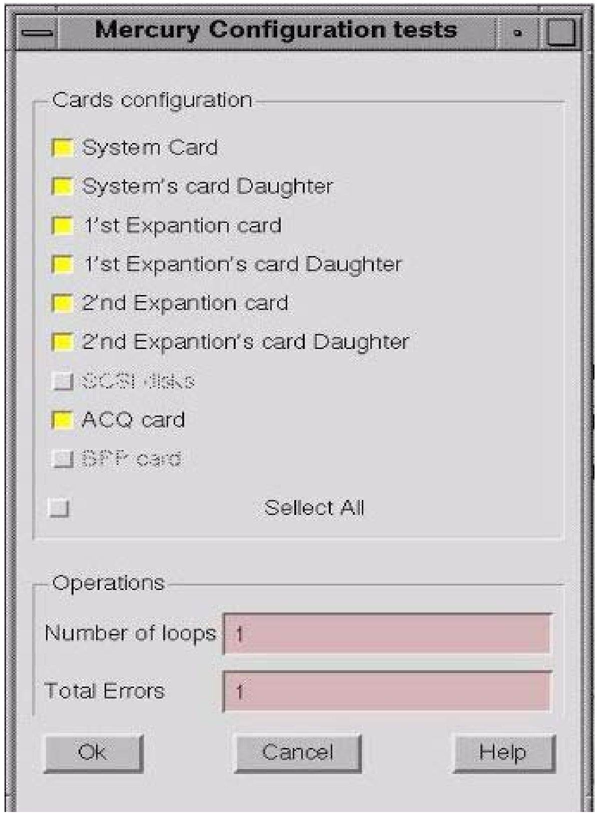
This feature enables the testing of single cards and even part of the card (e.g., testing only the system's daughter card).

Operations

Number of loops—enter the number of loops required for the test. The default is one.

Total Errors—enter the number of permissible errors. The test fails after the number of errors indicated. The default is one.

Look for messages on the screen while the tests are running. All tests must finish successfully. Generally a faulty card will abort the test and initiate a "Panic" situation. In this case, run the test for each card separately to find the faulty card.



Mercury Configuration tests

Cards configuration

- ☑ System Card
- ☑ System's card Daughter
- ☑ 1'st Expantion card
- ☑ 1'st Expantion's card Daughter
- ☑ 2'nd Expantion card
- ☑ 2'nd Expantion's card Daughter
- ☐ SCSI disks
- ☑ ACQ card
- ☐ SFP card
- ☐ Select All

Operations

Number of loops: 1

Total Errors: 1

Figure 2-44: Configmc Test Setting—All Cards Enabled For Testing

NOTE:

Performing the Configmc test using this setting takes approximately one minute per loop.

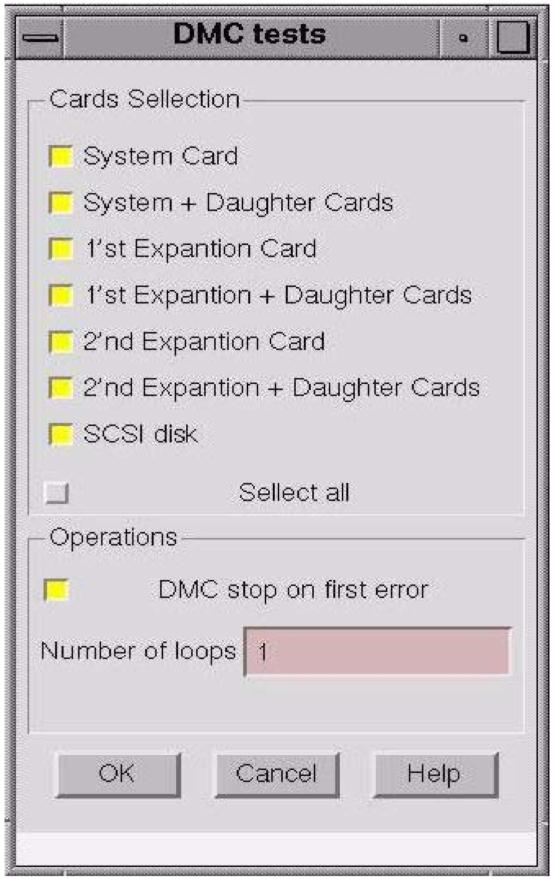
DMC Test

The tests performed check the following (see *Figure 2-45*):

- Incremental check of each sharc
- Data pattern is transferred between every 4 sharcs
- RACEway (bus) between all cards
- Writing from sharc to sharc through the RACEway
- In each sharc the first CE writes to the expansion memory
- Loop back for SCSI communication verification (system card)

NOTE:

Before executing the DMC test, ResetMercury is performed. If the ResetMercury fails, the test is aborted and “Panic” occurs. Refer to the *"Configmc Test" on page 2-100*.



DMC tests

Cards Selection

☑ System Card
☑ System + Daughter Cards
☑ 1’st Expantion Card
☑ 1’st Expantion + Daughter Cards
☑ 2’nd Expantion Card
☑ 2’nd Expantion + Daughter Cards
☑ SCSI disk
☐ Select all

Operations

☑ DMC stop on first error

Number of loops: 1

Figure 2-45: DMC Test Setting

NOTE:

Do not perform the SCSI test here. It's results are unclear. For the SCSI test and for more extensive DMC testing, see *"DMC Diagnostic (using Mercury Commands)"*

Operations

DMC stop on first error—click to have the test fail after the first error.

Number of loops—enter the number of loops required for the test. The default is one.

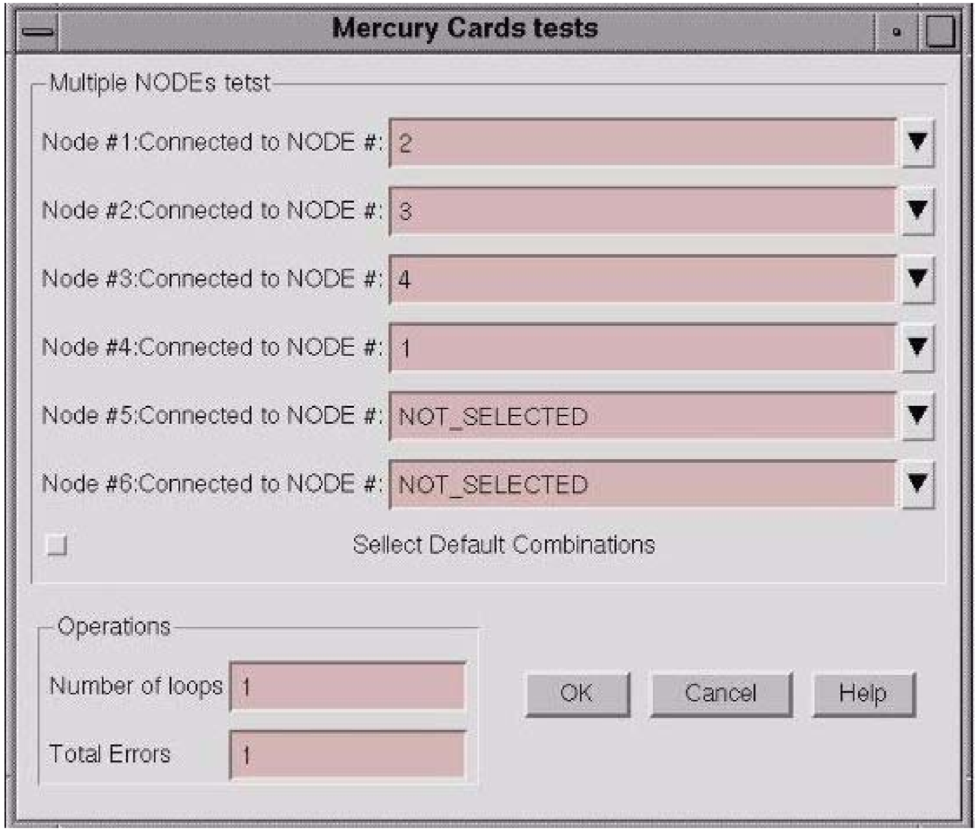
NOTE:

Performing the DMC test (*Figure 2-45*) using this setup takes approximately 35 minutes.

Mercury Test

The Mercury test checks communication between the first sharcs located at the system and the Expansion cards through the PCI Bus and through the PCILK card (see *Figure 2-46*). Software for communication is loaded to each sharc and then communication takes place as defined by the user settings.

> **Node**—is a cluster of four sharcs. During the test, each first sharc in the node communicates with the sharcs of the corresponding node.



Multiple NODEs tetst

Node #1:Connected to NODE #: 2

Node #2:Connected to NODE #: 3

Node #3:Connected to NODE #: 4

Node #4:Connected to NODE #: 1

Node #5:Connected to NODE #: NOT_SELECTED

Node #6:Connected to NODE #: NOT_SELECTED

☐ Select Default Combinations

Operations

Number of loops 1

Total Errors 1

Figure 2-46: Mercury Test Setting

NOTE:

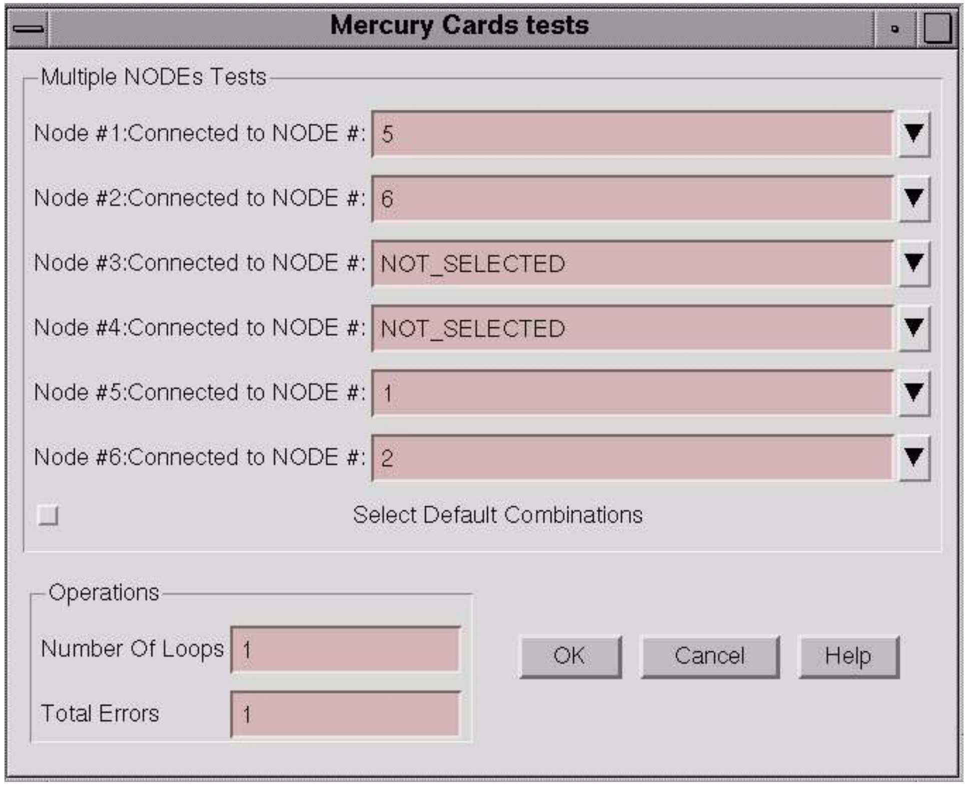
ResetMercury is performed as part of this test. If the ResetMercury fails, the test is aborted and “Panic” occurs. Refer to the *“Configmc Test”*.

Operations

Number of loops—enter the number of loops required for the test. The default is one.

Total Errors—enter the number of permissible errors. The test fails after the number of errors indicated. The default is one.

> NOTE:
>
> Due to a software bug, the maximum setup for the communication test is a maximum of 4 nodes per test. Selection of six nodes at one time will result in an error message.
> See the example in *Figure 2-46*. In *Figure 2-47*, nodes 1, 2, 5, and 6 on the system card and 2nd expansion card were selected. A node can be tested by itself; for example, node 1 can communicate with itself.



Multiple NODEs Tests

Node #1:Connected to NODE #: 5
Node #2:Connected to NODE #: 6
Node #3:Connected to NODE #: NOT_SELECTED
Node #4:Connected to NODE #: NOT_SELECTED
Node #5:Connected to NODE #: 1
Node #6:Connected to NODE #: 2

☐ Select Default Combinations

Operations

Number Of Loops: 1
Total Errors: 1

Figure 2-47: Mercury Test using Nodes 1, 2, 5, and 6

> NOTE:
>
> Performing the Mercury test using this setting takes approximately 90 seconds per loop.

SCSI Test

The purpose of this test is to check the SCSI disks and the system card.

⚠ CAUTION

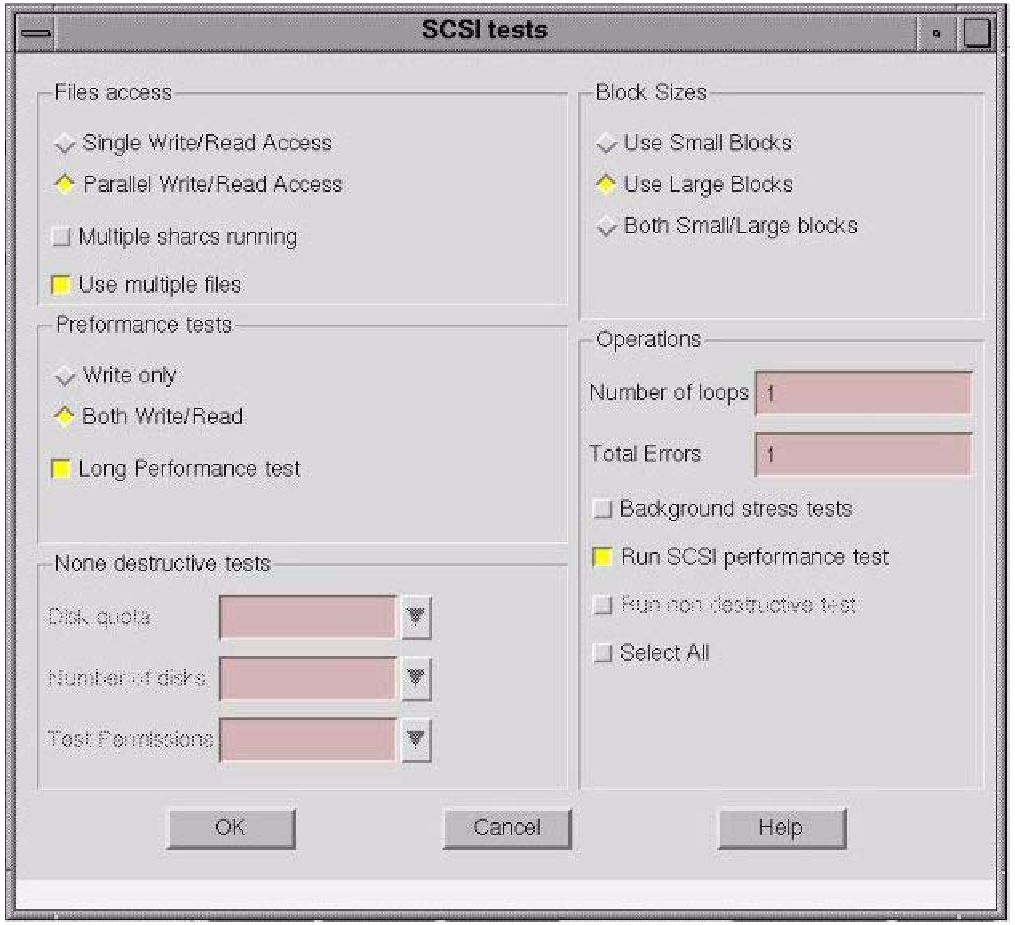
PARTS OF THE SCSI TESTS ARE DESTRUCTIVE BECAUSE, WHILE THE TEST IS RUNNING, DATA BLOCKS ARE WRITTEN TO THE DISKS TO FULL CAPACITY. THEREFORE, **ALL** RAW/PREP WILL BE LOST!
IF THE RAW DATA IS TO BE USED IN THE FUTURE, COPY IT TO AN EOD. FOLLOW THE PROCEDURE LISTED BELOW.

Copying Raw Data to an EOD

1. Select **Processing|Viewer**. The Archive Manager window appears
2. Click **IRS** and highlight the desired files from the list.
3. Select **File|Copy Images**. The Copy Images window appears.
4. Select **EOD** to save to an EOD, or select **Local disk** to copy to the host computer.
5. Click **OK**.

⚠ CAUTION

THIS PROCEDURE IS VALID ONLY FOR RAW DATA FILES UP TO 25MB. FOR LARGER FILES, USE THE PROCEDURE OUTLINED IN TECHNICAL NOTE 23A "FTP CONNECTION TO THE MX8000".



SCSI tests

Files access
- ○ Single Write/Read Access
- ● Parallel Write/Read Access
- ☐ Multiple shares running
- ☑ Use multiple files

Preformance tests
- ○ Write only
- ● Both Write/Read
- ☑ Long Performance test

None destructive tests
- Disk quota
- Number of disks
- Test Permissions

Block Sizes
- ○ Use Small Blocks
- ● Use Large Blocks
- ○ Both Small/Large blocks

Operations
- Number of loops: 1
- Total Errors: 1
- ☐ Background stress tests
- ☑ Run SCSI performance test
- ☐ Run non destructive test
- ☐ Select All

Figure 2-48: SCSI Disk Test Setting

The setup displayed in *Figure 2-48* is the recommended one.

Running the test produces a graph, **Read Write Performance**, as in *Figure 2-49*.

Explanation Of Parameters in the SCSI Tests Setting

Files access

Checks the basic ability of Write/Read to disks. A sharc opens a process and Write/reads to the SCSI disks.

Single Write/Read Access—only one process running.

Parallel Write/Read Access—several processes are running.

Multiple sharcs running—system card sharcs are used.

Use multiple files— use files in sequence for read/write function

Performance tests

Write only—writes to the first 500Mb of SCSI disks capacity.

Both Write/Read—Write/Read to the first 500Mb of SCSI disks capacity.

Long Performance test—uses all SCSI disks capacity. If not selected, only the first 500Mb of SCSI disks capacity are tested.

Block Sizes

Use Small Blocks—4Kb

Use Large Blocks—3Mb (test takes shorter time)

Both Small/Large blocks—use both block sizes

Operations

Number of loops—enter the number of loops required for the test. The default is one.

Total Errors—enter the number of permissible errors. The test fails after the number of errors indicated. The default is one.

Background stress tests—extra tasks for sharcs, making the test more difficult for the hardware.

Run SCSI performance test—depending on other settings, the test is writing/reading to all of the disk’s capacity (long performance test) or to the first 500MB (see "Performance Tests" above).

NOTE:

Performing the Long Performance test of SCSI disk test takes approximately 55 minutes, depending on the disk capacity (tested on 3x18Gb).

SCSI Performance Graphs

The following graphs are examples of various disk performance tests:

The normal Read/Write is ~18Mb/sec. for Read and 16Mb/sec. for Write (as in the figure above). A slower rate (less than 10Mb/sec.) indicates on a slow/faulty disk. It is not possible to identify the abnormal disk from the graph. In this case replace the disk array. The possible arrays are:

- 407-7180-9502—complete SCSI drive array 9.1Gb x 4 disks
- 407-7181-7604—complete SCSI drive array 18Gb x 3 disks

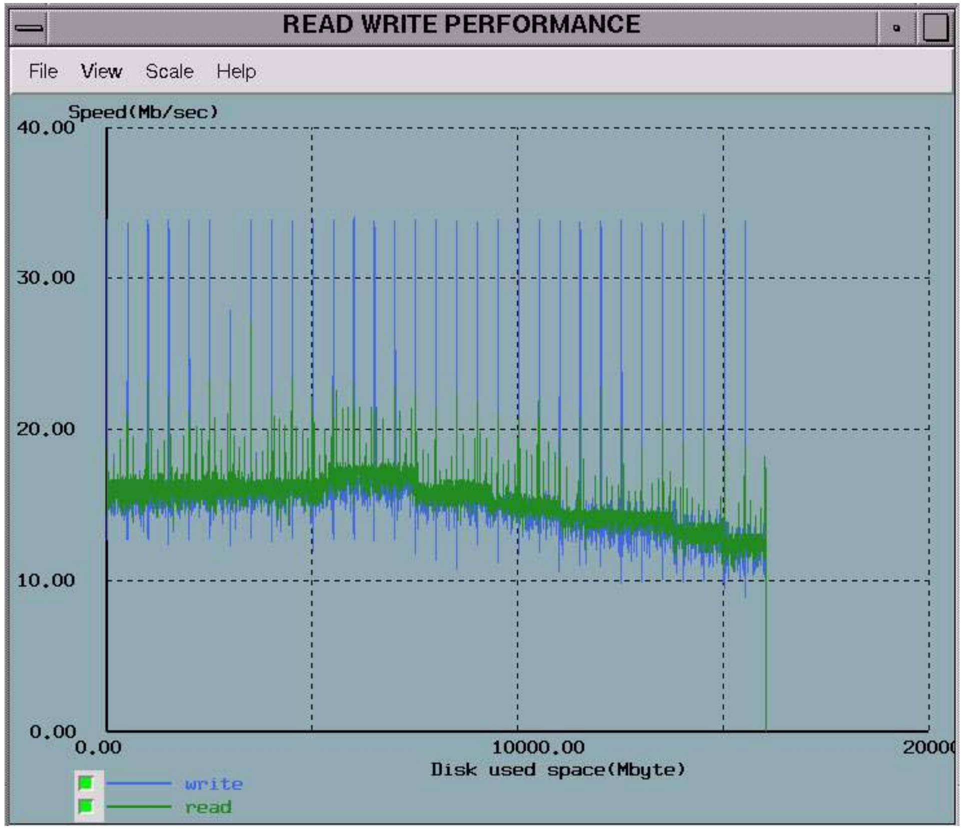

READ WRITE PERFORMANCE
File
View
Scale
Help
Speed(Mb/sec)
40.00
30.00
20.00
10.00
0.00
0.00
10000.00
2000(
Disk used space(Mbyte)
write
read

Figure 2-49: Read/Write Performance Test Output 4x4.3Gb SCSI Disks

NOTE:

It is possible to determine which disk is faulty by disconnecting each disk in turn or pairs of disks from the array and repeating the test till the graph indicates the faster disk's performance.

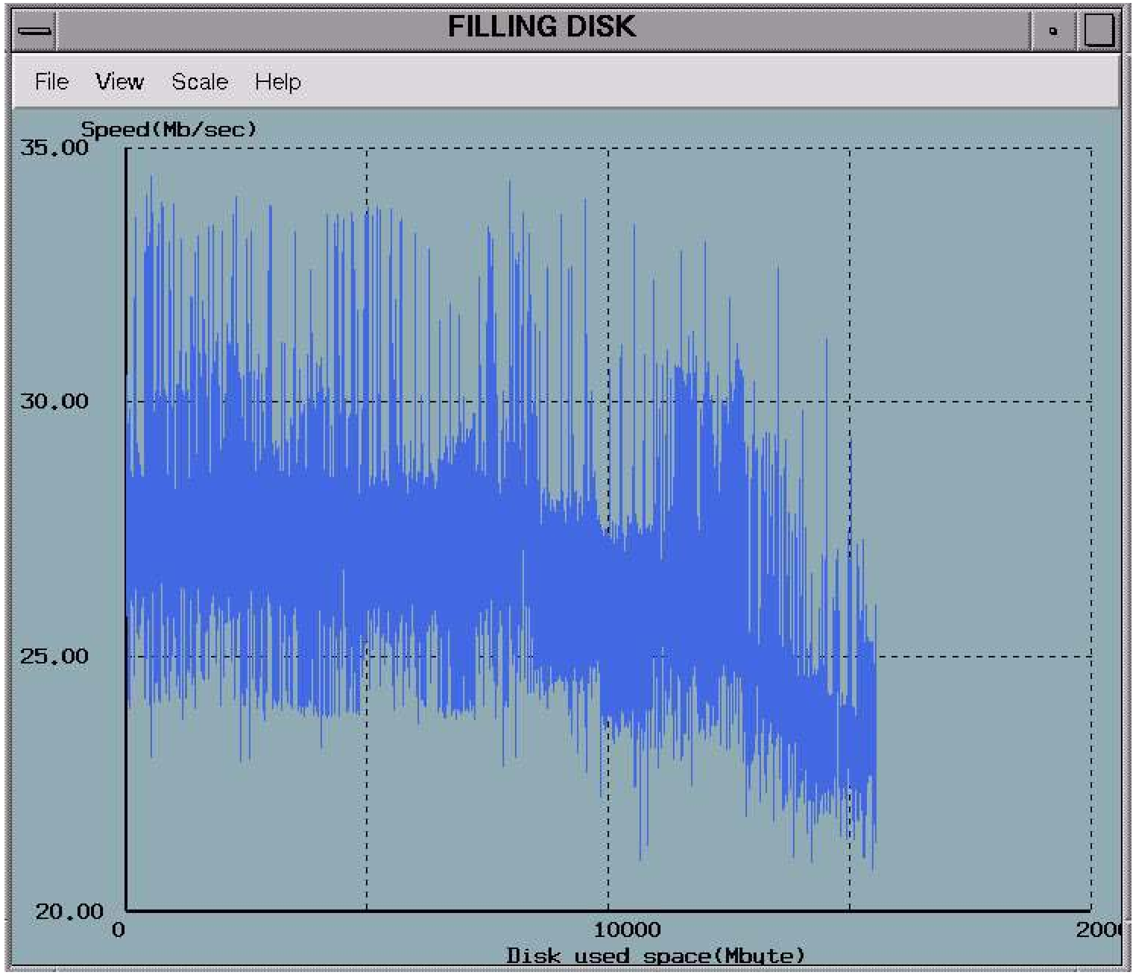
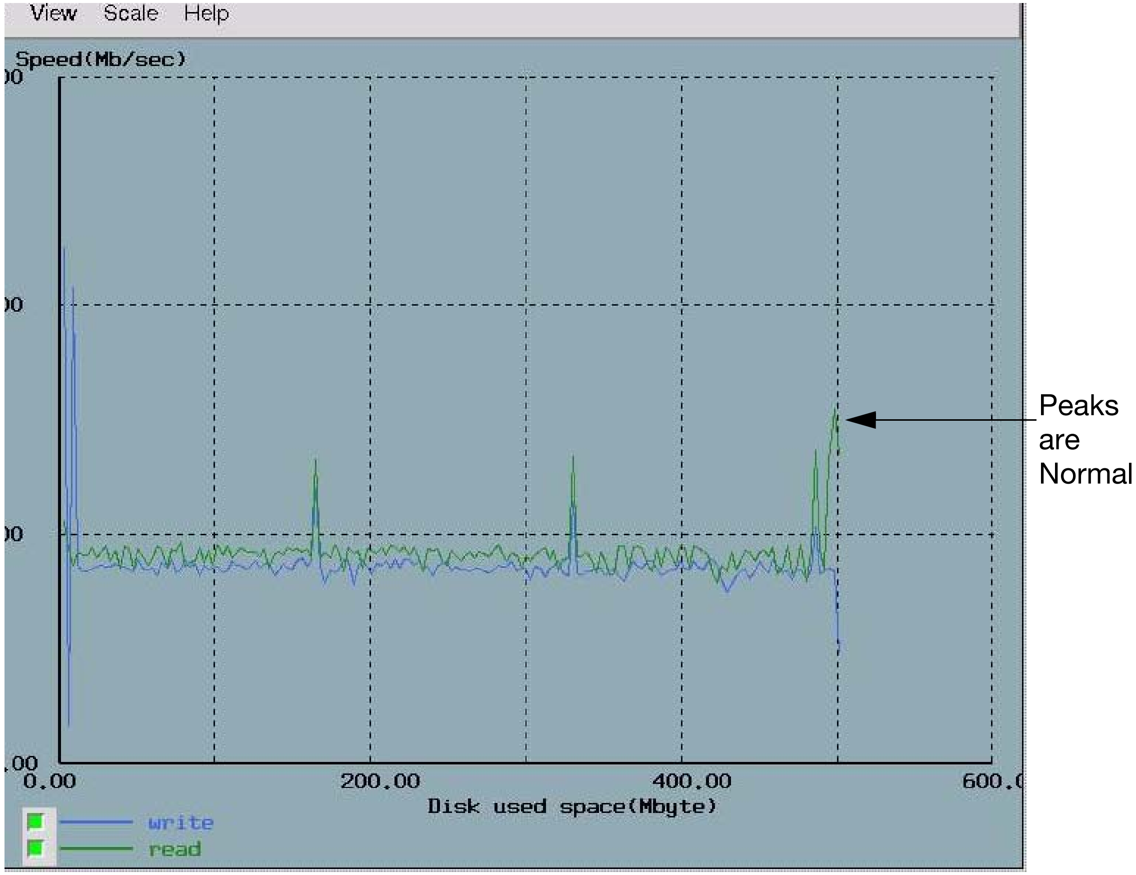

FILLING DISK
File
View
Scale
Help
Speed(Mb/sec)
35.00
30.00
25.00
20.00
0
10000
200
Disk used space(Mbyte)

Figure 2-50: SCSI Disk Performance Write-only 4x4.3Gb

The graph shows a small decline at the end of the SCSI disks array capacity. This is normal.


View
Scale
Help
Speed(Mb/sec)
00
00
00
.00
0.00
200.00
400.00
600.
Disk used space(Mbyte)
write
read

Peaks are Normal

Figure 2-51: Read/Write Performance Test Output of First 500Mb of 3x18Gb SCSI Disks (Performed with Software Version 2.21)

NOTES:

- Performing the Read/Write performance test output for the first 500Mb takes approximately three minutes.
- Software limitations (including version 2.21) currently do not allow the use of the Long Performance Read/Write Test. If this test is attempted, the resulting graph is meaningless.
- Software version 2.2 does not support tests of disks larger than 9.1 Gb.

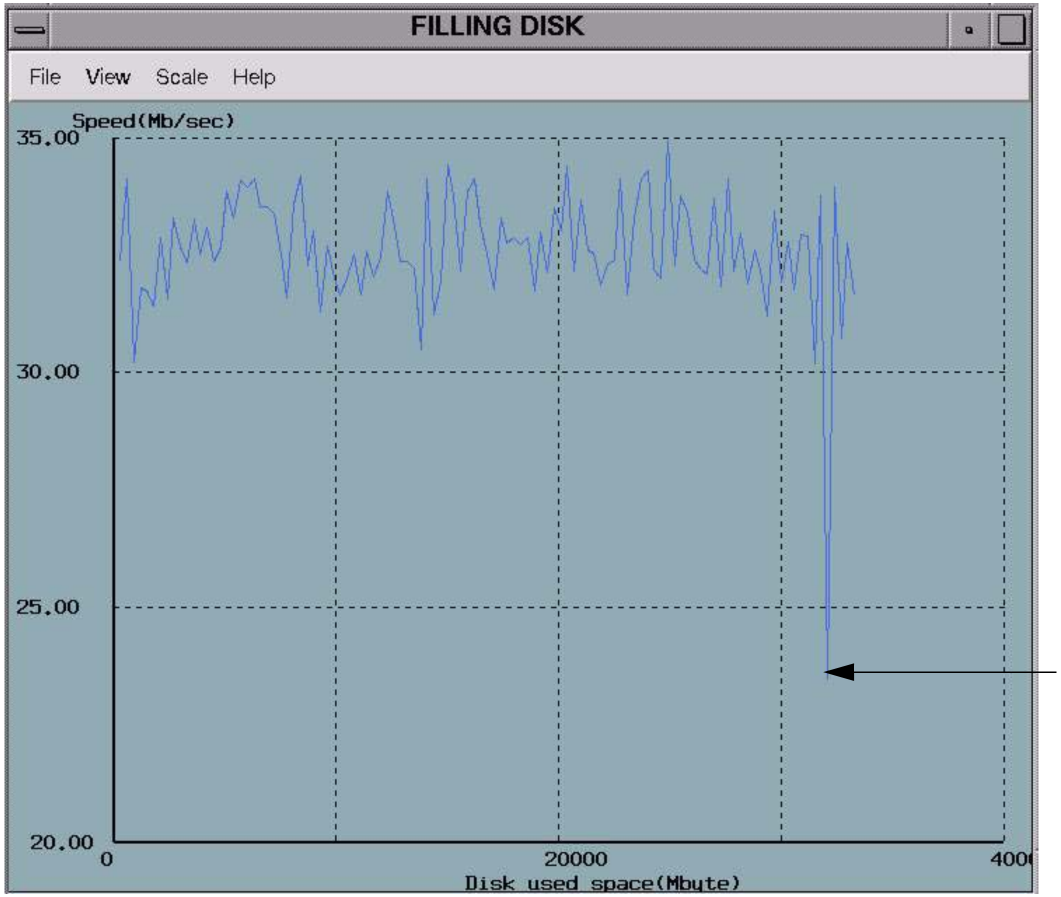

FILLING DISK
File
View
Scale
Help
Speed(Mb/sec)
35.00
30.00
25.00
20.00
0
20000
400
Disk used space(Mbyte)
"Single" Rate Drops

Figure 2-52: Write Only Performance Test Output 4x9.1Gb SCSI Disks

NOTE:

"Single" rate drops to a lower limit of ~22Mb/sec. are allowed.

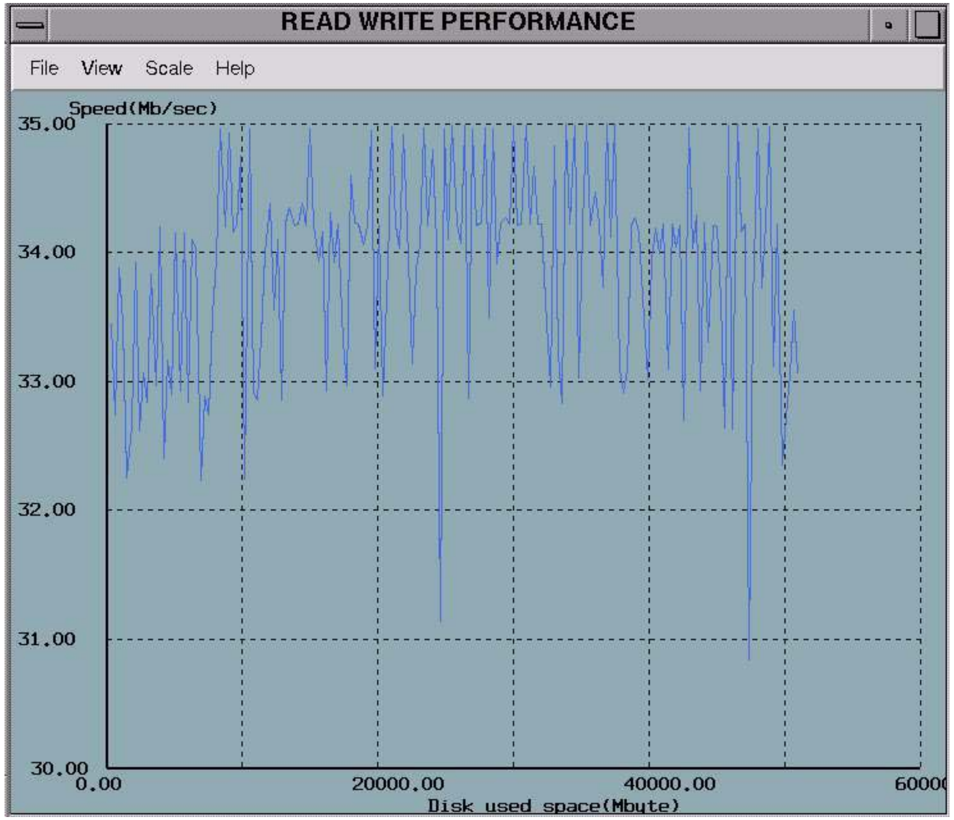

READ WRITE PERFORMANCE
File
View
Scale
Help
Speed(Mb/sec)
35.00
34.00
33.00
32.00
31.00
30.00
0.00
20000.00
40000.00
6000
Disk used space(Mbyte)

Figure 2-53: Write Only Performance Test Output 3x18Gb SCSI Disks (Performed with Software Version 2.21)

The maximum rate is ~35Mb/sec. The upper limit is determined by the SCSI disks controller performance.

Graphs of Faulty SCSI Disks

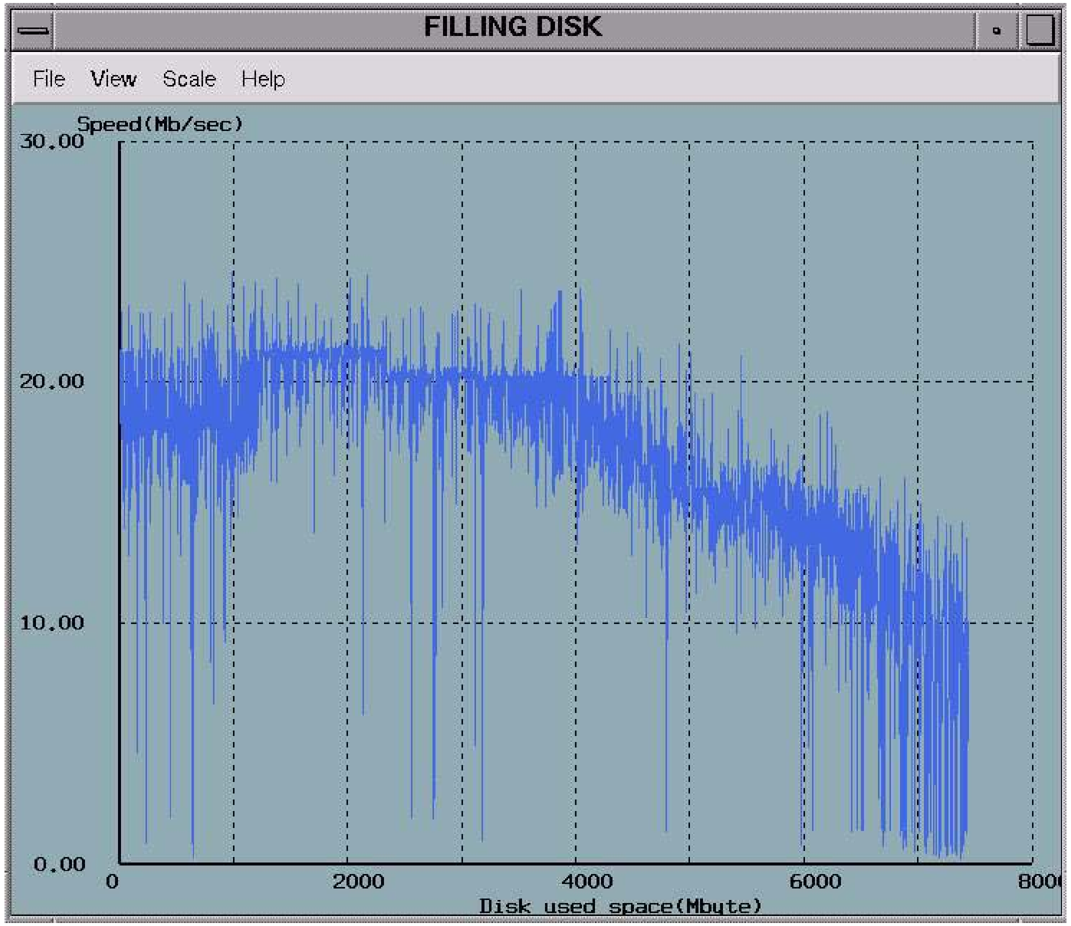

FILLING DISK
File
View
Scale
Help
Speed(Mb/sec)
30.00
20.00
10.00
0.00
0
2000
4000
6000
800
Disk used space(Mbyte)

Figure 2-54: SCSI Disk Performance Write-only 2x4.3Gb

The above figure represents two faulty 4.3Gb SCSI disks (un-nominal configuration), as tested on a test batch. The rate drops sharply.

ACQ Tests

The purpose of this test is to check the Acquisitor card and its communication with the system card and the SCSI disks.

> **NOTE:**
>
> Before running the ACQ tests, ensure that the System and Expansion cards are functioning OK.

Explanation Of Parameters in the ACQ Tests Setting

PCI Tests

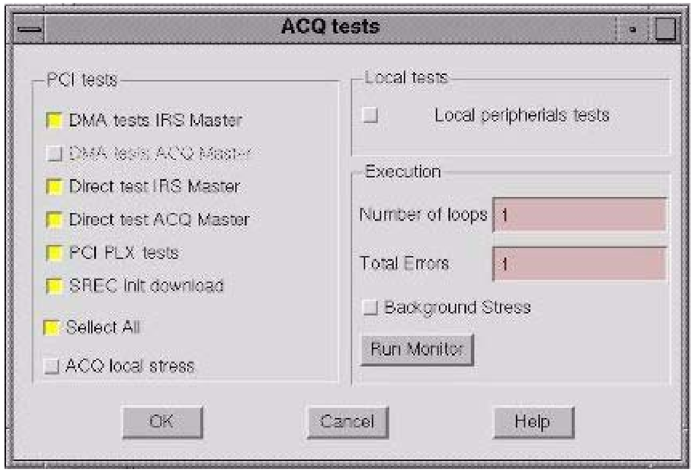
DMA tests IRS Master—performs DMA access from the system card's DRAM into the ACQ card memory.

Direct test IRS Master—performs direct access from the system card's DRAM into the ACQ card memory.

Direct test ACQ Master—performs direct write from the ACQ card RISC into the system card's SRAM.

PCI PLX tests—writes a pattern into the PLX I.C. The two internal tests are:

- — ACQ RISC
- — System card writing



☑ DMA tests IRS Master
☐ DMA tests ACQ Master
☑ Direct test IRS Master
☑ Direct test ACQ Master
☑ PCI PLX tests
☑ SREC Init download
☑ Sellect All
☐ ACQ local stress

☐ Local peripherials tests

Number of loops: 1
Total Errors: 1
☐ Background Stress

Figure 2-55: ACQ Test Setting

SREC Init download—downloads software codes, and in the direct access mode writes the codes into the following:

— IRS Rade disks
— ACQ card’s memory

This is done repeatedly, back and forth.

ACQ local stress— an internal ACQ test. The RISC checks the card’s subsystems.

Local tests

Local peripherals tests—an internal test for the local ICs of the ACQ board. It checks the card’s PLX, URT, and timer.

Execution

Number of loops—enter the number of loops required for the test. The default is one.

Total Errors—enter the number of permissible errors. The test fails after the number of errors indicated. The default is one.

Background Stress—extra tasks for sharcs, making the test more difficult for the hardware.

Run Monitor—opens the ACQ Monitor window.

A failure in one or more of the ACQ tests requires the card replacement.

NOTE:

Performing the ACQ tests using this setting take approximately 90 seconds per loop.

BPP Tests

The purpose of this test is to verify proper operation of the BPP card.

The test performs the Back projection stage of the reconstruction process done by the BPP card.

The output of the test is an image as in Fig. 2-64.

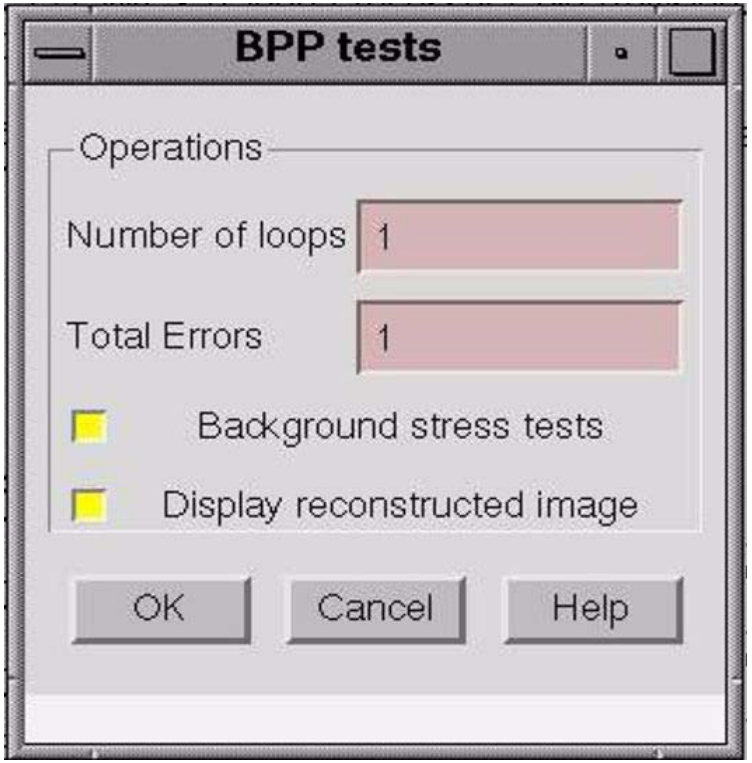
The image has to be free of artifacts and can be “windowed” using the mouse. Replace the BPP card in case there is no image at all, if there is a bad image, or if the test fails.

Operations

Number of loops—enter the number of loops required for the test. The default is one.

Total Errors—enter the number of permissible errors. The test fails after the number of errors indicated. The default is one.

Background stress tests—extra tasks for sharcs, making the test more difficult for the hardware.



Number of loops 1

Total Errors 1

☐ Background stress tests

☐ Display reconstructed image

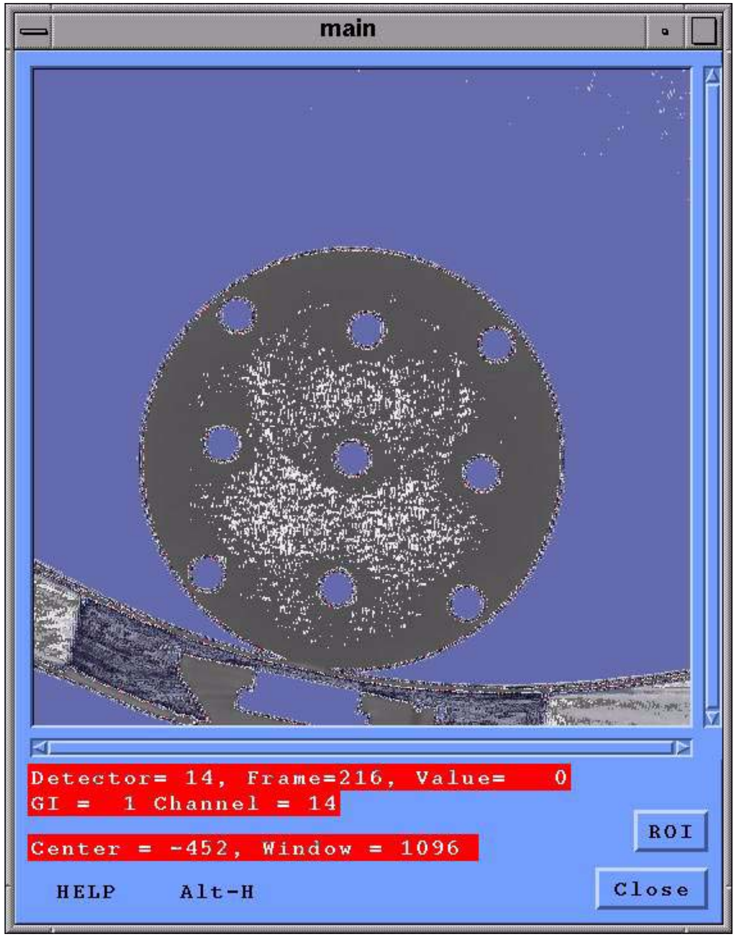
Figure 2-56: BPP Test Setting

NOTE:

Due to a problem in image-capturing *Figure 2-57* does not appear as on the monitor screen.

NOTE:

Performing the BPP tests using this setting take approximately two minutes per loop.



```
Detector= 14, Frame=216, Value=     0
GI =   1 Channel = 14
Center = -452, Window = 1096
```

Figure 2-57: Reconstructed Image

Part 3

Commands and Supplementary Data

NOTE:

The following conventions are used in this document:

- An item emphasized in `blue` is useful data from the printout.
- Items emphasized in `red` are notes added to help in identifying possible problems.

The “hinv” Command

Use the **hinv** command to determine the hardware inventory of the workstation.

1. Login as **root** (password **pkserv99**).
2. Type: **hinv and press <enter>.**

The following is the **hinv** command output of an Mx8000 Quad system (24 sharcs). The reporting of the “Bus“ and “Slot” locations (emphasized in blue) are the “logical addresses” used by the host to identify the physical bus and slot locations.

```
sys9071 2# hinv
Video: MVP unit 0 version 1.4
AV: AV1 Card version 1, Camera not connected.
FLASH PROM version 4.13
On-board serial ports: 2
On-board EPP/ECP parallel port
1 200 MHZ IP32 Processor
FPU: MIPS R5000 Floating Point Coprocessor Revision: 1.0
CPU: MIPS R5000 Processor Chip Revision: 2.1
Data cache size: 32 Kbytes
Instruction cache size: 32 Kbytes
Secondary unified instruction/data cache size: 1 Mbyte on Processor 0
Main memory size: 1024 Mbytes
```

```
Iris Audio Processor: version A3 revision 0
Integral Ethernet: ec0, version 1
  Optical disk: unit 3 on SCSI controller 1
  CDROM: unit 4 on SCSI controller 0
  Disk drive: unit 1 on SCSI controller 0
CRM graphics installed
Mass Storage PCI: Bus 3, Slot 7, Function 0, Vendor ID 0x1134, Device ID 0x1    No driver      Mercury Expansion
2 card
Unknown Type PCI: Bus 3, Slot 6, Function 0, Vendor ID 0x10b5, Device ID 0x906d No driver         PBB card
Unknown Type PCI: Bus 3, Slot 5, Function 0, Vendor ID 0x10b5, Device ID 0x9050 No driver         CIB card
Mass Storage PCI: Bus 3, Slot 4, Function 0, Vendor ID 0x1134, Device ID 0x1    No driver      Mercury Expansion
1 card
Unknown Type PCI: Bus 2, Slot 7, Function 0, Vendor ID 0x10b5, Device ID 0x906e No driver       Acquisitor card
Mass Storage PCI: Bus 2, Slot 6, Function 0, Vendor ID 0x1134, Device ID 0x1    No driver         System card
Bit3 PCI Bridge Card: Bus 2, Slot 4  Controller (on the IRS Motherboard)
Bit3 PCI Bridge Card: Bus 1, Slot 4  Motherboard
Bit3 PCI Bridge Card: Bus 0, Slot 3  Host adaptor card (in the 02)
Integral SCSI controller 1: Version ADAPTEC 7880
Integral SCSI controller 0: Version ADAPTEC 7880
Vice: TRE
```

NOTE:

Note the following when running the hinv command on a Mx8000 Dual standard (16 sharc) IRS configuration):

- Mercury Expansion # 2 is not installed.
- The PBB card is installed into physical slot 6 of the IRS MB – reported as logical Bus 3, Slot 7.

The SYSLOG File

The SYSLOG file contains the system boot data. The SGI O2 computer and IRS boot information is displayed in a window during the O2 boot cycle (the IRS must be switched **ON** to have IRS devices reported and saved to the SYSLOG file).

> **NOTE:**
>
> The CIB and the 3 PCI Bridge Cards are not reported to the SYSLOG file.

To view the contents of the SYSLOG file:

1. Login as **root** (password **pkserv99**).
2. Type: **cd / and press <enter>.**
3. Type: **cd /var/adm and press <enter>.**
4. Type: **more syslog and press <enter>.**

The following information is displayed on the screen:

```
restart
 Copyright 1987-1996 Silicon Graphics, Inc.
 All Rights Reserved.

 devpce_init: start registration
 devpce_attach: vhdl=0x80881754.
 devpce_attach: my_device_info=0x80881770.
 devpce_attach: cfg_addr = 0x80023000
 devpce_attach: base_addr_0 = 0xc0006000
 devpce_attach: base_addr_1 = 0xc4006000
 devpce_attach: base_addr_2 = 0xb8001000
 devpce_attach: base_addr_3 = 0xc6006000
 devpce_attach: vendor_device_id = 0x1
 devpce_attach: int_handle = 0x80881830
 devpce_attach: bus number = 0x2(Mercury System card)
 devpce_attach: device number = 0x6
```

```
devpce_attach: function number = 0x0
devpce_attach: adding minor number = 0
devpce_attach: setting up global buffer for host SMBs
devpce_attach: my_global_buf_size 0xe00000
devpce_attach: os__host_buffer_status 0x1
devpce_attach: os__host_buffer_ptr = 0xa088f000
devpce_attach: *os__host_buffer_ptr = 0x0
devpce_attach: host buffer initialized
devpce_attach: vhdl=0x8088184c.
devpce_attach: my_device_info=0x80881868.
devpce_attach: cfg_addr = 0x80032000
devpce_attach: base_addr_0 = 0xc6107000
devpce_attach: base_addr_1 = 0xc7107000
devpce_attach: base_addr_3 = 0xcb107000
devpce_attach: vendor_id = 0x1134
devpce_attach: vendor_device_id = 0x1
devpce_attach: int_handle = 0x80881928
devpce_attach: bus number = 0x3(Mercury Expansion #1)
devpce_attach: device number = 0x4
devpce_attach: function number = 0x0
devpce_attach: adding minor number = 1
devpce_attach: vhdl=0x80881944.
devpce_attach: my_device_info=0x80881960.
devpce_attach: cfg_addr = 0x80033800
devpce_attach: base_addr_0 = 0xc9107000
devpce_attach: base_addr_1 = 0xca107000
devpce_attach: base_addr_3 = 0xcb207000
devpce_attach: vendor_id = 0x1134
devpce_attach: vendor_device_id = 0x1
devpce_attach: int_handle = 0x80881a2c
devpce_attach: bus number = 0x3(Mercury Expansion #2)
devpce_attach: device number = 0x7
devpce_attach: function number = 0x0
devpce_attach: adding minor number = 2
devpce_attach: vhdl=0x80881a70.
devpce_attach: my_device_info=0x80881a8c.
devpce_attach: cfg_addr = 0x80023800
devpce_attach: base_addr_0 = 0xc6106000
```

```
devpce_attach: base_addr_1 = 0xb8001100
devpce_attach: base_addr_2 = 0xc5006000
devpce_attach: vendor_id = 0x10b5
devpce_attach: vendor_device_id = 0x906e
devpce_attach: int_handle = 0x80881b58
devpce_attach: bus number = 0x2(Acquisitor card)
devpce_attach: device number = 0x7
devpce_attach: function number = 0x0
devpce_attach: adding minor number = 3
devpce_attach: vhdl=0x80881c8c.
devpce_attach: my_device_info=0x80881ca8.
devpce_attach: cfg_addr = 0x80033000
devpce_attach: base_addr_0 = 0xcb307000
devpce_attach: base_addr_1 = 0xb8002000
devpce_attach: base_addr_2 = 0xc8107000
devpce_attach: vendor_id = 0x10b5
devpce_attach: vendor_device_id = 0x906d
devpce_attach: int_handle = 0x80881d74
devpce_attach: bus number = 0x3(PBB card)
devpce_attach: device number = 0x6
devpce_attach: function number = 0x0
devpce_attach: adding minor number = 4
devpce_init: end registration
NOTICE: Start mounting filesystem: /
NOTICE: Starting XFS recovery on filesystem: / (dev: 128/16)
NOTICE: Ending XFS recovery for filesystem: / (dev: 128/16)
```

NOTE:

The SYSLOG file does not report the presence of the CIB or the three PCI Bridge locations.

Note on systems with a 24 sharc IRS:
While observing the monitor during the O2 boot cycle, the message: “adding minor number = 4” must appear on the screen. If this message fails to appear, or if the last “minor number” reported is less than 4, the software did not sense the presence of one or more of the IRS cards.

Note on Mx8000 Dual systems with a 16 sharc IRS:
While observing the monitor during the O2 boot cycle, the message: “adding minor number = 3” must appear on the screen. If this message fails to appear, or if the last “minor number” reported is less than 3, the software did not sense the presence of one or more of the IRS cards.

Example of a Problem During Boot-up

> **NOTE:**
>
> PCI errors scrolling on the console monitor during boot-up are not saved to the /var/adm/SYSLOG file.

```
syslogd: restart
06e
devpce_attach: int_handle = 0x80881648
devpce_attach: bus number = 0x2(Acquisitor)
devpce_attach: device number = 0x7
devpce_attach: function number = 0x0
devpce_attach: adding minor number = 1
devpce_init: end registration
NOTICE: Start mounting filesystem: /
NOTICE: Starting XFS recovery on filesystem: / (dev:128/16)
NOTICE: Ending XFS recovery for filesystem: / (dev:128/16)
inetd[166]: /usr/etc/rpc.mountd: No such file or directory
last message repeated 3 times
inetd[166]: /usr/etc/rpc.rwalld: No such file or directory
inetd[166]: /usr/etc/rpc.rusersd: No such file or directory
inetd[166]: /usr/etc/rpc.rquotad: No such file or directory
inetd[166]: /usr/etc/rpc.sprayd: No such file or directory
```

```
inetd[166]: /usr/etc/rpc.bootparamd: No such file or directory
mediad: couldn't find DSO for device at SCSI ctlr 1, id 3
dmb[559]: started
```

In the above **SYSLOG** file the system has acknowledged the presence of the Acquisitor card only (see the printout of the hinv command in *"The "hinv" Command"*).

When the user attempts to login to the Application Software a red message box appears on the screen with the message: **IRS SERVER FAILED.**

The cause of this problem could be a defective Mercury System card.

Diagnostic Tools and Commands

The current software v2.51 for the Mx8000 Quad /Dual include IRS diagnostic software programs accessible from the main login screen by clicking the **Diagnostic** icon. The IRS diagnostic tools accessible from the main login screen are incomplete—not all tests are available or completely functional. Refer to the Version 2.51 S/W document for instructions.

Setting the Environment for the "sdiag", "sdf" and "sls" Commands

NOTE:

Executing the **sdiag**, **sdf**, and **sls** commands as a "root" login from the main login screen is not possible. The system will return a "cannot connect to scsi_server" error. These commands may be executed from the **Service** login.

Set the Environment for the **sdiag**, **sdf**, and **sls** commands as follows:

1. From the main login screen, login as **Service** (password: **service_**).
2. After the system has completed a ResetMercury, right click on the desktop and select either **New Window** (password: **letmein**) or
   New Window (root) (password: **pkserv99**). Either choice will set up the proper environment for the **sdiag**, **sdf**, and **sls** commands.

3. Type: **cd / and press <enter>.**
4. Type: **cd /usr/diamond.root/irsbin/scsi_shell and press <enter>.**

> **NOTE:**
>
> If “new window (root)” was selected, the “./” prefix must be added before the command (e.g. ./sls).

The **sdiag**, **sdf**, and **sls** commands can also be performed from the Application software by selecting **Service Terminal** from the **Service** menu:

1. From **Service** in the Application Software, click **Service Terminal**. In the **Service Terminal** window, enter the password (**letmein**).
2. Type: **cd / and press <enter>.**
3. Type: **cd /usr/diamond.root/irsbin/scsi_shell and press <enter>.**

Executing the “sdiag”, “sdf” and “sls” Commands

sdiag Command

The **sdiag** command performs a hardware and software check of the IRS SCSI disks. This command also causes the Mercury System Card to check its connection to the SCSI drives.

Type**:** **sdiag** and press **<enter>**. After several seconds a message appears on screen (the useful data is highlighted in blue):

```
Performing hardware diagnostics...     OK
Performing software diagnostics...     OK

Disk Configuration:
Total number of disks             4
Logical block size                512 bytes
Stripe size                       131072 bytes
Max. number of data files         512
Size of data directory entry      256 bytes
Max. number of table files        2048
```

```
Size of table directory entry     128 bytes
Size of data file area            15943168 Kbytes
Size of table file area           1048576 Kbytes
```

sdf Command

The sdf command provides IRS SCSI disk information.

Type: **sdf** and press **<enter>.** A message appears on screen:

```
> sdf

Data directory:
Total free:            15943424 Kb
Max. contiguous free: 15943424 Kb


Table directory:
Total free:            1030639 Kb
Max. contiguous free: 1015896 Kb
```

sls Command

The **sls** command output is a list of all Raw/Prep data files stored on the IRS disks.

Type: **sls** and press **<enter>**. A message appears on screen:

```
> sls
Data directory:

1.2.840.113704.1.1762558780.13904.970009520.5111111111111111106390016 Nov  2 10:30:45 2000
1.2.840.113704.1.1762558780.13904.970009721.8111111111111111106390016 Nov  2 10:31:41 2000
1.2.840.113704.1.1762567988.11637.974675516.5111111111111111228193280 Nov 28 12:47:45 2000
```

There are 3 Raw data files in the example.

Commands to Be Used in Case of a Reconstruction Problem

ps24 Command

The ps24 command is to be used after attempting the reconstruction of raw data.

The ps24 command is useful when reconstruction halts or no image is produced. The ps24 command shows the current state of all CEs. Normally all CEs are in a READY state after a reconstruction has been performed. To verify the state of all CEs following an attempted reconstruction:

1. Attempt to reconstruct an image.
2. From the “Service” pull down menu open the “Service Terminal” and enter the password (letmein).
3. Type: **cd / and press <enter>.**
4. Type: **cd /usr/diamond.root/IRSbin and press <enter>.**
5. Type: **ps24 and press <enter>.**

The following example is the output of the **ps24** command on a system with no reconstruction problems. A problem in the reconstruction system might be seen as an error in a CE or CEs and no READY State will be seen. A bad Mercury card can be identified according to the location of the bad CEs.

NOTE:

A 16 sharc IRS configuration (Mx8000 Dual) has only one Mercury Expansion card installed.

Sharcs Tasks during Reconstruction (Axial Scan–24 Sharcs)

- Prep tasks—CEs 5–8,and 14–17 (Surview only)
- Filter task—CEs 18–21
- IBC task—CE 13 (Irregular Bone Correction)
- Axial and spiral interpolation tasks—CEs 10–12
- Image balance task— CEs 22–25

Other Sharcs Tasks

- ACQ tasks—CE 9
- SCSI and others—CEs 2–4

The following example is from a 24sharc IRS configuration (the blue color is used to emphasize some data. It shows each CE task performed during reconstruction):

- CEs 2-5 are on the Mercury System Card
- CEs 6-9 are on the Mercury System Card’s Daughter card
- CEs 10-13 are on the Mercury Expansion # 1 card
- CEs 14-17 are on Mercury Expansion # 1’s Daughter card
- CEs 18-21 are on the Mercury Expansion #2 card
- CEs 22-25 are on Mercury Expansion #2’s daughter card

Printout of the ps24 Command (24 Sharc System)

```
csd: /usr/diamond.V2.01/IRSbin > ps24
CE 2 (CEID2), Running, unreserved, name server 2
 PID        Image   State     Flags Block_id Args  (2 processes)
 0x0020100 0020000 Readyk
 0x0020101 0020001 Ready       scsi_server.sharc -m -s sda -bulk zmod
Images:
 Image-Id  Path
 0x0020000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x0020001 /usr/diamond.V2.01/IRSbin/scsi_server.sharc
CE 3 (CEID3), Running, unreserved, name server 2
 PID        Image   State     Flags Block_id Args  (2 processes)
 0x0030100 0030000 Readyk
 0x0030101 0030001 Ready      ./MaSh.sharc -f
Images:
 Image-Id  Path
 0x0030000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x0030001 /usr/diamond.V2.01/IRSbin/MaSh.sharc
CE 4 (CEID4), Running, unreserved, name server 2
 PID        Image   State     Flags Block_id Args  (2 processes)
 0x0040100 0040000 Readyk
 0x0040101 0040001 Ready    Pipe2File.sharc -refresh_rate
Images:
 Image-Id  Path
 0x0040000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0040001 /usr/diamond.V2.01/IRSbin/Pipe2File.sharc
CE 5 (CEID5), Running, unreserved, name server 2
 PID        Image   State     Flags Block_id Args  (2 processes)
 0x0050100 0050000 Readyk
 0x0050101 0050001 Ready    PrepTglR.sharc
Images:
 Image-Id  Path
 0x0050000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0050001 /usr/diamond.V2.01/IRSbin/PrepTglR.sharc
```

```
CE 6 (CEID6), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0060100 0060000 Readyk
 0x0060101 0060001 Ready   PrepTgmR.sharc -refresh_rate
Images:
 Image-Id  Path
 0x0060000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x0060001 /usr/diamond.V2.01/IRSbin/PrepTgmR.sharc
CE 7 (CEID7), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0070100 0070000 Readyk
 0x0070101 0070001 Ready   PrepTgmR.sharc
Images:
 Image-Id  Path
 0x0070000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x0070001 /usr/diamond.V2.01/IRSbin/PrepTgmR.sharc
CE 8 (CEID8), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0080100 0080000 Readyk
 0x0080101 0080001 Ready   PrepTgmR.sharc
Images:
 Image-Id  Path
 0x0080000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0080001 /usr/diamond.V2.01/IRSbin/PrepTgmR.sharc
CE 9 (CEID9), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0090100 0090000 Readyk
 0x0090101 0090001 Ready   AcqFile.sharc
Images:
 Image-Id  Path
 0x0090000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0090001 /usr/diamond.V2.01/IRSbin/AcqFile.sharc
```

```
CE 10 (CEID10), Running, unreserved, name server 2
 PID        Image   State     Flags Block_id Args  (2 processes)
 0x00a0100 00a0000 Readyk
 0x00a0101 00a0001 Ready   SpiralRebinR.sharc -no_error -refresh_rate
Images:
 Image-Id  Path
 0x00a0000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x00a0001 /usr/diamond.V2.01/IRSbin/SpiralRebinR.sharc
CE 11 (CEID11), Running, unreserved, name server 2
 PID        Image   State     Flags Block_id Args  (2 processes)
 0x00b0100 00b0000 Readyk
 0x00b0101 00b0001 Ready    SpiralRebinPrepmFR.sharc -no_error
Images:
 Image-Id  Path
 0x00b0000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x00b0001 /usr/diamond.V2.01/IRSbin/SpiralRebinPrepmFR.sharc
CE 12 (CEID12), Running, unreserved, name server 2
 PID        Image   State     Flags Block_id Args  (2 processes)
 0x00c0100 00c0000 Readyk
 0x00c0101 00c0001 ReadySpiralRebinPrepmFR.sharc -no_error
Images:
 Image-Id  Path
 0x00c0000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x00c0001 /usr/diamond.V2.01/IRSbin/SpiralRebinPrepmFR.sharc
CE 13 (CEID13), Running, unreserved, name server 2
 PID        Image   State     Flags Block_id Args  (2 processes)
 0x00d0100 00d0000 Readyk
 0x00d0101 00d0001 Ready   IbcFPR.sharc
Images:
 Image-Id  Path
 0x00d0000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x00d0001 /usr/diamond.V2.01/IRSbin/IbcFPR.sharc
```

```
CE 14 (CEID14), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x00e0100 00e0000 Readyk
 0x00e0101 00e0001 Ready   PrepmSurvR.sharc -refresh_rate
Images:
 Image-Id  Path
 0x00e0000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x00e0001 /usr/diamond.V2.01/IRSbin/PrepmSurvR.sharc
CE 15 (CEID15), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x00f0100 00f0000 Readyk
 0x00f0101 00f0001 Ready   PrepmSurvR.sharc
Images:
 Image-Id  Path
 0x00f0000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x00f0001 /usr/diamond.V2.01/IRSbin/PrepmSurvR.sharc
CE 16 (CEID16), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processe)
 0x0100100 0100000 Readyk
 0x0100101 0100001 Ready   PrepmSurvR.sharc
Images:
 Image-Id  Path
 0x0100000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0100001 /usr/diamond.V2.01/IRSbin/PrepmSurvR.sharc
CE 17 (CEID17), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0110100 0110000 Readyk
 0x0110101 0110001 Ready   PrepmSurvR.sharc
Images:
 Image-Id  Path
 0x0110000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0110001 /usr/diamond.V2.01/IRSbin/PrepmSurvR.sharc
```

```
CE 18 (CEID18), Running, unreserved, name server 2
 PID        Image    State     Flags Block_id Args  (2 processes)
 0x0120100 0120000 Readyk
 0x0120101 0120001 Ready   FilterBPR.sharc -no_tilt -refresh_rate
Images:
 Image-Id  Path
 0x0120000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x0120001 /usr/diamond.V2.01/IRSbin/FilterBPR.sharc
CE 19 (CEID19), Running, unreserved, name server 2
 PID        Image    State     Flags Block_id Args  (2 processes)
 0x0130100 0130000 Readyk
 0x0130101 0130001 Ready   FilterBPR.sharc -no_tilt
Images:
 Image-Id  Path
 0x0130000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x0130001 /usr/diamond.V2.01/IRSbin/FilterBPR.sharc
CE 20 (CEID20), Running, unreserved, name server 2
 PID        Image    State     Flags Block_id Args  (2 processes)
 0x0140100 0140000 Readyk
 0x0140101 0140001 Ready   FilterBPR.sharc -no_tilt
Images:
 Image-Id  Path
 0x0140000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0140001 /usr/diamond.V2.01/IRSbin/FilterBPR.sharc
CE 21 (CEID21), Running, unreserved, name server 2
 PID        Image    State     Flags Block_id Args  (2 processes)
 0x0150100 0150000 Readyk
 0x0150101 0150001 ReadyFilterBPR.sharc -no_tilt
Images:
 Image-Id  Path
 0x0150000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0150001 /usr/diamond.V2.01/IRSbin/FilterBPR.sharc
```

```
CE 22 (CEID22), Running, unreserved, name server 2
 PID       Image   State    Flags Block_id Args  (2 processes)
 0x0160100 0160000 Readyk
 0x0160101 0160001 ReadyImBalR.sharc -no_error -refresh_rate
Images:
 Image-Id  Path
 0x0160000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x0160001 /usr/diamond.V2.01/IRSbin/ImBalR.sharc
CE 23 (CEID23), Running, unreserved, name server 2
 PID       Image   State    Flags Block_id Args  (2 processes)
 0x0170100 0170000 Readyk
 0x0170101 0170001 ReadyImBalR.sharc -no_error
Images:
 Image-Id  Path
 0x0170000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x0170001 /usr/diamond.V2.01/IRSbin/ImBalR.sharc
CE 24 (CEID24), Running, unreserved, name server 2
 PID       Image   State    Flags Block_id Args  (2 processe))
 0x0180100 0180000 Readyk
 0x0180101 0180001 ReadyImBalR.sharc -no_error
Images:
 Image-Id  Path
 0x0180000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0180001 /usr/diamond.V2.01/IRSbin/ImBalR.sharc
CE 25 (CEID25), Running, unreserved, name server 2
 PID       Image   State    Flags Block_id Args  (2 processes)
 0x0190100 0190000 Readyk
 0x0190101 0190001 ReadyImBalR.sharc -no_error
Images:
 Image-Id  Path
 0x0190000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0190001 /usr/diamond.V2.01/IRSbin/ImBalR.sharc
```

The following is an example of a faulty Expansion 2 card. The problem in this example is that reconstruction is STUCK with *no error message*.

When the **ps24** command is used, the following is output is displayed on the screen: (Note: only the Expansion 2 data is showed.)

CEs 18-21 (shown in blue) are faulty; e.g., there is a problem with the Mercury Expansion #2 card.

```
CE 18 (CEID18), Running, unreserved, name server 2
 CE not responding.
CE 19 (CEID19), Running, unreserved, name server 2
 CE not responding.
CE 20 (CEID20), Running, unreserved, name server 2
 CE not responding.
CE 21 (CEID21), Running, unreserved, name server 2
 CE not responding.
CE 22 (CEID22), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0160100 0160000 Readyk
 0x0160101 0160001 ReadyImBalR.sharc -no_error -refresh_rate
Images:
 Image-Id  Path
 0x0160000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x0160001 /usr/diamond.V2.01/IRSbin/ImBalR.sharc
CE 23 (CEID23), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0170100 0170000 Readyk
 0x0170101 0170001 ReadyImBalR.sharc -no_error
Images:
 Image-Id  Path
 0x0170000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x0170001 /usr/diamond.V2.01/IRSbin/ImBalR.sharc
CE 24 (CEID24), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0180100 0180000 Readyk
 0x0180101 0180001 ReadyImBalR.sharc -no_error
Images:
 Image-Id  Path
 0x0180000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0180001 /usr/diamond.V2.01/IRSbin/ImBalR.sharc
```

```
CE 25 (CEID25), Running, unreserved, name server 2
 PID        Image    State     Flags Block_id Args  (2 processes)
 0x0190100 0190000 Readyk
 0x0190101 0190001 ReadyImBalR.sharc -no_error
Images:
 Image-Id  Path
 0x0190000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0190001 /usr/diamond.V2.01/IRSbin/ImBalR.sharc
```

Printout of the ps24 Command (16 Sharc System–Dual)

```
CE 2 (CEID2), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0020100 0020000 Ready     k
 0x0020101 0020001 Ready           scsi_server.sharc -s sda -bulk zmod
Images:
 Image-Id  Path
 0x0020000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x0020001 /usr/diamond.V2.2/IRSbin/scsi_server.sharc
CE 3 (CEID3), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0030100 0030000 Ready     k
 0x0030101 0030001 Ready                    ./MaSh.sharc -f
Images:
 Image-Id  Path
 0x0030000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x0030001 /usr/diamond.V2.2/IRSbin/MaSh.sharc
CE 4 (CEID4), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0040100 0040000 Ready     k
 0x0040101 0040001 Ready                Pipe2File.sharc -refresh_rate
Images:
 Image-Id  Path
 0x0040000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0040001 /usr/diamond.V2.2/IRSbin/Pipe2File.sharc
CE 5 (CEID5), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0050100 0050000 Ready     k
 0x0050101 0050001 Ready                    PrepTglR.sharc
Images:
 Image-Id  Path
 0x0050000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0050001 /usr/diamond.V2.2/IRSbin/PrepTglR.sharc
```

```
CE 6 (CEID6), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0060100 0060000 Ready     k
 0x0060101 0060001 Ready                 PrepTgmR.sharc -refresh_rate
Images:
 Image-Id  Path
 0x0060000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x0060001 /usr/diamond.V2.2/IRSbin/PrepTgmR.sharc
CE 7 (CEID7), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0070100 0070000 Ready     k
 0x0070101 0070001 Ready                    PrepTgmR.sharc
Images:
 Image-Id  Path
 0x0070000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x0070001 /usr/diamond.V2.2/IRSbin/PrepTgmR.sharc
CE 8 (CEID8), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0080100 0080000 Ready     k
 0x0080101 0080001 Ready                    PrepTgmR.sharc
Images:
 Image-Id  Path
 0x0080000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0080001 /usr/diamond.V2.2/IRSbin/PrepTgmR.sharc
CE 9 (CEID9), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0090100 0090000 Ready     k
 0x0090101 0090001 Ready                    AcqFile.sharc
Images:
 Image-Id  Path
 0x0090000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0090001 /usr/diamond.V2.2/IRSbin/AcqFile.sharc
```

```
CE 10 (CEID10), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x00a0100 00a0000 Ready     k
 0x00a0101 00a0001 Ready               SurvSpRebFR.sharc -refresh_rate
Images:
 Image-Id  Path
 0x00a0000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x00a0001 /usr/diamond.V2.2/IRSbin/SurvSpRebFR.sharc
CE 11 (CEID11), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x00b0100 00b0000 Ready     k
 0x00b0101 00b0001 Ready                    SurvSpRebFR.sharc
Images:
 Image-Id  Path
 0x00b0000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x00b0001 /usr/diamond.V2.2/IRSbin/SurvSpRebFR.sharc
CE 12 (CEID12), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x00c0100 00c0000 Ready     k
 0x00c0101 00c0001 Ready                    SurvSpRebFR.sharc
Images:
 Image-Id  Path
 0x00c0000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x00c0001 /usr/diamond.V2.2/IRSbin/SurvSpRebFR.sharc
CE 13 (CEID13), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x00d0100 00d0000 Ready     k
 0x00d0101 00d0001 Ready                    SurvImBalR.sharc
Images:
 Image-Id  Path
 0x00d0000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x00d0001 /usr/diamond.V2.2/IRSbin/SurvImBalR.sharc
```

```
CE 14 (CEID14), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x00e0100 00e0000 Ready     k
 0x00e0101 00e0001 Ready        FilterBPR.sharc -no_tilt -refresh_rate
Images:
 Image-Id  Path
 0x00e0000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x00e0001 /usr/diamond.V2.2/IRSbin/FilterBPR.sharc
CE 15 (CEID15), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x00f0100 00f0000 Ready     k
 0x00f0101 00f0001 Ready                    PrepTgmR.sharc
Images:
 Image-Id  Path
 0x00f0000 /mercury/mcs-5.1.1/mercury/lib/exec2.sharc
 0x00f0001 /usr/diamond.V2.2/IRSbin/PrepTgmR.sharc
CE 16 (CEID16), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0100100 0100000 Ready     k
 0x0100101 0100001 Ready                    IbcFPR.sharc
Images:
 Image-Id  Path
 0x0100000 /mercury/mcs-5.1.1/mercury/lib/exec3.sharc
 0x0100001 /usr/diamond.V2.2/IRSbin/IbcFPR.sharc
CE 17 (CEID17), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0110100 0110000 Ready     k
 0x0110101 0110001 Ready                    FilterBPR.sharc -no_tilt
Images:
 Image-Id  Path
 0x0110000 /mercury/mcs-5.1.1/mercury/lib/exec4.sharc
 0x0110001 /usr/diamond.V2.2/IRSbin/FilterBPR.sharc
sysmc error: SYS_INVALID_CE_ID: invalid CE ID specified
sysmc error: SYS_INVALID_CE_ID: invalid CE ID specified
sysmc error: SYS_INVALID_CE_ID: invalid CE ID specified
sysmc error: SYS_INVALID_CE_ID: invalid CE ID specified
sysmc error: SYS_INVALID_CE_ID: invalid CE ID specified
sysmc error: SYS_INVALID_CE_ID: invalid CE ID specified
sysmc error: SYS_INVALID_CE_ID: invalid CE ID specified
sysmc error: SYS_INVALID_CE_ID: invalid CE ID specified
sys2106: /usr/diamond.root/IRSbin > ps16
sys2106: /usr/diamond.root/IRSbin > ps24
CE 2 (CEID2), Running, unreserved, name server 2
 PID       Image   State     Flags Block_id Args  (2 processes)
 0x0020100 0020000 Ready     k
 0x0020101 0020001 Ready                    scsi_server.sharc -s sda -bulk zmod
Images:
 Image-Id  Path
 0x0020000 /mercury/mcs-5.1.1/mercury/lib/exec1.sharc
 0x0020001 /usr/diamond.V2.2/IRSbin/scsi_server.sharc
CE 3 (CEID3), Running, unreserved, name server 2
```

irsmon Command

Like the **ps24** command, the **irsmon** command is used after attempting reconstruction of raw data to identify a failed CE (sharc) or associated device.

1. From **Service** in the Application Software, click **Service Terminal**. In the **Service Terminal** window, enter the password (**letmein**).
2. Type: **cd / and press <enter>.**
3. Type: **cd /usr/diamond.root/IRSbin and press <enter>.**
4. Type: **irsmon and press <enter>.**

The following appears on the screen:

```
Enter option:
   <ce number> SRAM trace
  d<ce number> DRAM trace
  c<ce number> System control
  i<ce number> Work Bureau - Toggle idle
  l<ce number> Set debug level
  p<ce number> Pause
  r<ce number> release (unpause)
  a [<ce number]> Save into files all trace
  w. Work Bureau
  x. Toggle debug flag
  t. Toggle time prints
  x. Toggle numbering (index) prints
 q. Quit
```

Type in the CE number (3 thru 25) to be viewed. For example, enter the CE number of the sharc to be displayed. To select another CE, enter the appropriate CE number.

irsmon output example #1

8

```
<IrsMonitorOnSharc_print_sram_buf>: CEID=8

-------- Start of SRAM buffer ------------
1>(8) WorkBureau_wait_assignment: Waits work (1) ...

2 [   72135 -12526]>(8) WorkBureau_wait_assignment: Assigned to PrepMem (pipe 1)
3 [   76326   4191]><Tg_attach> PipeId 1 nTGMs 8 LeaderId 5 bLeader 0
4 [   76328    2]><Tg_attach_pipes_dram> InBufCpu 4 OutBufCpu 5
5 [  76430  102]>TGM_init start
6 [  76468   38]>No pre-allocated DMA, Allocate NOW! b2d 0
7 [  76826  358]>No pre-allocated DMA, Allocate NOW! b2d 0
8 [  79311 2485]>No pre-allocated DMA, Allocate NOW! b2d 0
9 [  79664  353]>No pre-allocated DMA, Allocate NOW! b2d 0
10 [   80023    359]>No pre-allocated DMA, Allocate NOW! b2d 0
11 [   80513    490]>No pre-allocated DMA, Allocate NOW! b2d 0
12 [   80880    367]>No pre-allocated DMA, Allocate NOW! b2d 0
13 [   81250    370]>No pre-allocated DMA, Allocate NOW! b2d 0
14 [   81611    361]>No pre-allocated DMA, Allocate NOW! b2d 0
15 [   83590   1979]>TGM_init succeeded
16 [   83593      3]>Doing prep...
17 [   84594   1001]>TGM_go_default: bCancel received.
18 [   84597      3]>bFinish(0), bCancel(1)
19 [   84599      2]>Total of (19) ranges processed.
20 [   84602      3]->close_prep_bufs started.
21 [   84641     39]>close_prep_bufs ended.
22 [   84672     31]>(8) WorkBureau_wait_assignment: Waits work (2) ...
-------- End of SRAM buffer ------------
Enter option:
   <ce number> SRAM trace
  d<ce number> DRAM trace
  c<ce number> System control
  i<ce number> Work Bureau - Toggle idle
  l<ce number> Set debug level
  p<ce number> Pause
```

```
 r<ce number> release (unpause)
 a [<ce number]> Save into files all trace
 w. Work Bureau
 x. Toggle debug flag
 t. Toggle time prints
 x. Toggle numbering (index) prints
q. Quit
```

irsmon did not report any errors associated with CE#8.

irsmon output example #2:

9

```
<IrsMonitorOnSharc_print_sram_buf>: CEID=9

-------- Start of SRAM buffer ------------
1><ACQ>AcqServer Version 1.21 (Risc version 1.25) Date: 13-7-99
2 [    1 -84671]><Acq_init_from_file> STAB/7180-1.sre
3 [  3 2]><Buf_part_load_from_file> STAB/7180-1.sre 1048576
4 [  1492   1489]><Buf_part_load_from_file> loaded 1411496
5 [  1797    305]><ACQ>SrecHndl=-27755008, SrecSize=1411504
6 [ 37127  35330]><ACQ>SrecHndl=-27755008, SrecSize=1411504
7 [ 85318  48191]><ACQ>SrecHndl=-27755008, SrecSize=1411504
8 [ 120491  35173]>ERROR: <AcqApi.c>: <ACQ>SREC Download Failed!
9 [  120552 61]>ERROR:<AcqApi.c>:<ACQ>AcqApi_init(...) failed
10 [  120566     14]><ACQ>ERROR: AcqCardInit () function Failed
11 [  120568      2]>CmdDataSize 104, acq_base_handle fe589fe0 uStatusBuf.hBuf fe587e00
12 [ 125542 4974]>(9) WorkBureau_wait_assignment:Waits work(1)..
-------- End of SRAM buffer ------------
Enter option:
    <ce number>  SRAM trace
 d <ce number>  DRAM trace
 c <ce number>  System control
 i <ce number>  Work Bureau - Toggle idle
 l <ce number>  Set debug level
 p <ce number> Pause
 r <ce number> release (unpause)
 a [<ce number>] Save into files all trace
 w. Work Bureau
 x. Toggle debug flag
 t. Toggle time prints
 n. Toggle numbering (index) prints
 q. Quit
```

In the above example, **irsmon** reported an error from CE#9 (red). In this example the ACQ card is faulty.

irsmon output example #3

In the following example CEs 18–21 are selected. The CE numbers are entered one-by one. Please note the following:

- In the following example the reconstruction provided NO image.
- The ps24 command indicated no CE related errors.

```
Enter option:
     <ce number>  SRAM trace
 d <ce number>  DRAM trace
 c <ce number>  System control
 i <ce number>  Work Bureau - Toggle idle
 l <ce number>  Set debug level
 p <ce number> Pause
 r <ce number> release (unpause)
 a [<ce number>] Save into files all trace
 w. Work Bureau
 x. Toggle debug flag
 t. Toggle time prints
 n. Toggle numbering (index) prints
 q. Quit
18

<IrsMonitorOnSharc_print_sram_buf>: CEID=18

-------- Start of SRAM buffer ------------
/.........../

39 [   49636  -6279]><TgPi2ImaInit> created SMB <P2IB1>
40 [   49643      7]><TgPi2ImaInit> pointers determined in DRAM
41 [   49685     42]><TgPi2ImaInit> obese weights calculated
42 [   50304    619]><TgPi2ImaInit> complex kernel derivatives calculated
43 [   51130    826]><TgPi2ImaInit> required hot loop allocation size Bank 0 = 5518044 [   51144
14]><TgPi2ImaInit> required hot loop allocation size Bank 1 = 6528045 [   51156     12]>TgPi2ImaInit ended
46 [   51162      6]>Working without tilt correction
47 [   52496   1334]>: Sem_create("IBC_BP_SEMAPHORE")
48 [   54470   1974]><FilterBP_leader> All TGMs have finished GET_READY
49 [   54471      1]>new state: TG_STATE_READY
50 [   54495     24]>new state: TG_STATE_WORKING
```

```
51 [   54496      1]><tgPi2ImaTgm> Starting DoFilterBP
52 [  55736   1240]>ERROR: <>: Siemens TRACE_ERROR <pbb_lib.c:5764> -402619622 1001 -402652390 0
53 [   55835     99]>ERROR: <>: Siemens TRACE_ERROR <pbb_lib.c:5575> -402619622 0 0
54 [   55936    101]>ERROR: <>: Siemens TRACE_ERROR <pbb_lib.c:2948> -402619622 0 0
55 [   56003     67]>ERROR: <>: Error E800831A occurred calling feedPbb()
56 [   56064     61]>ERROR: <>: <DoFilterBP> failed
57 [   56081     17]>new state: TG_STATE_FAILED
58 [   56120      39]><Tg_detach_pipes> PipeBuf_read_end
59 [   56122       2]><Tg_detach_pipes> PipeBuf_write_end
60 [   56124       2]><Tg_detach> FilterBP Pipe#1
61 [   56128       4]>(18) WorkBureau_wait_assignment: Waits work (2) ...


-------- End of SRAM buffer ------------
Enter option:
    <ce number>  SRAM trace
 d <ce number>  DRAM trace
 c <ce number>  System control
 i <ce number>  Work Bureau - Toggle idle
 l <ce number>  Set debug level
 p <ce number> Pause
 r <ce number> release (unpause)
 a [<ce number>] Save into files all trace
 w. Work Bureau
 x. Toggle debug flag
 t. Toggle time prints
 n. Toggle numbering (index) prints
 q. Quit
19



<IrsMonitorOnSharc_print_sram_buf>: CEID=19

-------- Start of SRAM buffer ------------
/........../
18 [   53229  -2899]><TgPi2ImaInit> obese weights calculated
19 [   53781    552]><TgPi2ImaInit> complex kernel derivatives calculated
```

```
20 [   54383    602]><TgPi2ImaInit> required hot loop allocation size Bank 0 = 5518021 [   54394
11]><TgPi2ImaInit> required hot loop allocation size Bank 1 = 6528022 [   54410     16]>TgPi2ImaInit ended
23 [   54411      1]>Working without tilt correction
24 [   54463     52]><tgPi2ImaTgm> Starting DoFilterBP
25 [   64869  10406]>ERROR: <Sem_wait>: Timeout waiting for semaphore BpCardSem
26 [   64916     47]>Semaphore BpCardSem FaceOK face Occupied 18 iQueue 19

Sharcs Flags
27 [   65003     87]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 0 0 0 0 0 0 0
28 [   65005      2]>
Sharcs Queue
29 [   65089     84]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

30 [   65215    126]>ERROR: <Pbb_get_sem>: Semaphore busy
31 [   65259     44]>Semaphore BpCardSem FaceOK face Occupied 18 iQueue 19

Sharcs Flags
32 [   65346     87]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 0 0 0 0 0 0 0
33 [   65349      3]>
Sharcs Queue
34 [   65433     84]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

35 [   65664    231]>ERROR: <>: Siemens TRACE_ERROR <pbb_lib.c:2948> -402619630 0 0 0
36 [   65847    183]>ERROR: <>: Error E8008312 occurred calling feedPbb()
37 [   66022    175]>ERROR: <>: <DoFilterBP> failed
38 [   66148    126]><Tg_detach_pipes> PipeBuf_read_end
39 [   66153      5]><Tg_detach_pipes> PipeBuf_write_end
40 [   66160      7]><Tg_detach> FilterBP Pipe#1
41 [   66167      7]>(19) WorkBureau_wait_assignment: Waits work (2) ...


-------- End of SRAM buffer ------------
Enter option:
    <ce number>  SRAM trace
 d <ce number>  DRAM trace
 c <ce number>  System control
 i <ce number>  Work Bureau - Toggle idle
 l <ce number>  Set debug level
 p <ce number> Pause
 r <ce number> release (unpause)
 a [<ce number>] Save into files all trace
 w. Work Bureau
 x. Toggle debug flag
 t. Toggle time prints
 n. Toggle numbering (index) prints
 q. Quit
```

20

```
<IrsMonitorOnSharc_print_sram_buf>: CEID=20

-------- Start of SRAM buffer ------------
/.........../
18 [   52225 -13942]><TgPi2ImaInit> obese weights calculated
19 [   52779    554]><TgPi2ImaInit> complex kernel derivatives calculated
20 [   53400    621]><TgPi2ImaInit> required hot loop allocation size Bank 0 = 5518021 [   53401
1]><TgPi2ImaInit> required hot loop allocation size Bank 1 = 6528022 [   53405      4]>TgPi2ImaInit ended
23 [   53406      1]>Working without tilt correction
24 [   53449     43]><tgPi2ImaTgm> Starting DoFilterBP
25 [   63851  10402]>ERROR: <Sem_wait>: Timeout waiting for semaphore BpCardSem
26 [   63898     47]>Semaphore BpCardSem FaceOK face Occupied 18 iQueue 19

Sharcs Flags
27 [   63985     87]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 0 0 0 0 0 0 0
28 [   63988      3]>
Sharcs Queue
29 [   64070     82]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

30 [   64198    128]>ERROR: <Pbb_get_sem>: Semaphore busy
31 [   64243     45]>Semaphore BpCardSem FaceOK face Occupied 18 iQueue 19

Sharcs Flags
32 [   64329     86]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 0 0 0 0 0 0 0
33 [   64331      2]>
```

```
Sharcs Queue
34 [   64413     82]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

35 [   64647    234]>ERROR: <>: Siemens TRACE_ERROR <pbb_lib.c:2948> -402619630 0 0 0
36 [   64831    184]>ERROR: <>: Error E8008312 occurred calling feedPbb()
37 [   65003    172]>ERROR: <>: <DoFilterBP> failed
38 [   65131    128]><Tg_detach_pipes> PipeBuf_read_end
39 [   65136      5]><Tg_detach_pipes> PipeBuf_write_end
40 [   65142      6]><Tg_detach> FilterBP Pipe#1
41 [   65150      8]>(20) WorkBureau_wait_assignment: Waits work (2) ...
-------- End of SRAM buffer ------------
Enter option:
    <ce number>  SRAM trace
 d <ce number>  DRAM trace
 c <ce number>  System control
 i <ce number>  Work Bureau - Toggle idle
 l <ce number>  Set debug level
 p <ce number> Pause
 r <ce number> release (unpause)
 a [<ce number>] Save into files all trace
 w. Work Bureau
 x. Toggle debug flag
 t. Toggle time prints
 n. Toggle numbering (index) prints
 q. Quit
```

21

```
<IrsMonitorOnSharc_print_sram_buf>: CEID=21
-------- Start of SRAM buffer ------------
/.........../
18 [   51969 -13181]><TgPi2ImaInit> obese weights calculated
19 [   52523    554]><TgPi2ImaInit> complex kernel derivatives calculated
20 [   53147    624]><TgPi2ImaInit> required hot loop allocation size Bank 0 = 5518021 [   53148
1]><TgPi2ImaInit> required hot loop allocation size Bank 1 = 6528022 [   53152      4]>TgPi2ImaInit ended
23 [   53153      1]>Working without tilt correction
24 [   53196     43]><tgPi2ImaTgm> Starting DoFilterBP
```

```
25 [   63590  10394]>ERROR: <Sem_wait>: Timeout waiting for semaphore BpCardSem
26 [   63637     47]>Semaphore BpCardSem FaceOK face Occupied 18 iQueue 19

Sharcs Flags
27 [   63719     82]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 0 0 0 0 0 0 0
28 [   63721      2]>
Sharcs Queue
29 [   63804     83]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

30 [   63937    133]>ERROR: <Pbb_get_sem>: Semaphore busy
31 [   63982     45]>Semaphore BpCardSem FaceOK face Occupied 18 iQueue 19

Sharcs Flags
32 [   64064     82]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 18 0 0 0 0 0 0 0
33 [   64066      2]>
Sharcs Queue
34 [   64148     82]>0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

35 [   64388    240]>ERROR: <>: Siemens TRACE_ERROR <pbb_lib.c:2948> -402619630 0 0 0
36 [   64570    182]>ERROR: <>: Error E8008312 occurred calling feedPbb()
37 [   64738    168]>ERROR: <>: <DoFilterBP> failed
38 [   64869    131]><Tg_detach_pipes> PipeBuf_read_end
39 [   64878      9]><Tg_detach_pipes> PipeBuf_write_end
40 [   64883      5]><Tg_detach> FilterBP Pipe#1
41 [   64891      8]>(21) WorkBureau_wait_assignment: Waits work (2…)
```

Note that CEs 18-21 have errors instead of the “normal” information.
In this case the faulty card is the Expansion 2 card.
Diagnosis: A faulty Mercury Expansion 2 card.

Examples of Other IRS Failures

Example #1

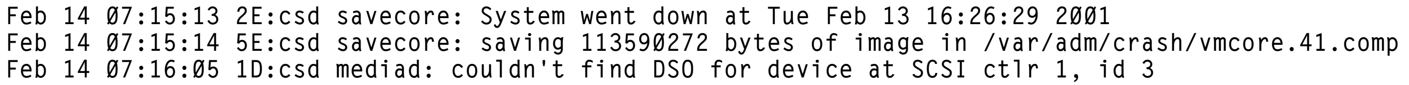
Problem Description:

System halted during login. After a long interval a message appears on a gray window:

```
PANIC: KERNEL FAULT
PC: 0x800789b0 ep:0xffffc728
.
.
.
.
SAVECORE :SAVING 113590272 bytes or image in /var/adm/crash/vmcore.41.comp
(press reset to restart the machine.)
```

The O2 has been restarted and during boot-up the message on the screen is (the following is part of the file /var/adm/ SYSLOG):

```
eb 14 07:15:13 2E:csd savecore: reboot after panic: <0>PANIC: KERNEL FAULT
Feb 14 07:15:13 2E:csd savecore: pb 0:
Feb 14 07:15:13 2E:csd savecore: pb 1: Error addr to Memory space for Retry error
Feb 14 07:15:13 2E:csd savecore: pb 2: CI Error: Address: ^C^?uO^C^?^?uG^C^??u?^C^?^?u7^C^?t 6, Function 0, Driver: devpce_
Feb 14 07:15:13 2E:csd savecore: pb 3: PCI Error: flags: 0x10210006
Feb 14 07:15:13 2E:csd savecore: pb 4: Error addr to Memory space for Retry error
Feb 14 07:15:13 2E:csd savecore: pb 5: devpce_error: error at pci addr. 0x8400005c code 0x10210006
Feb 14 07:15:13 2E:csd savecore: pb 6: PCI Error: Address: 0x8400005c
Feb 14 07:15:13 2E:csd savecore: pb 7: PCI Error: Bus 2, Slot 6, Function 0, Driver: devpce_
Feb 14 07:15:13 2E:csd savecore: pb 8: PCI Error: flags: 0x10210006
Feb 14 07:15:13 2E:csd savecore: pb 9: Error addr to Memory space for Retry error
Feb 14 07:15:13 2E:csd savecore: pb 10: devpce_error: error at pci add^C^?t^W^C^?t??t^G^C^?^?^?CI Error: Address: 0x84000064
Feb 14 07:15:13 2E:csd savecore: pb 11: PCI^C^?^?sO^C^?^?sG^C^?^?s?^C^?^?s7^C^?0, Driver: devpce_
Feb 14 07:15:13 2E:csd savecore: pb 12: PCI Error: flags: 0x10210006
Feb 14 07:15:13 2E:csd savecore: pb 13: Error addr to Memory space for Retry error
Feb 14 07:15:13 2E:csd savecore: pb 14: devpce_error: error at pci addr. 0x8400005c code 0x10210006
Feb 14 07:15:13 2E:csd savecore: pb 15: PCI Error: Address: 0x8400005c
Feb 14 07:15:13 2E:csd savecore: pb 16: PCI Error: Bus 2, Slot 6, Function 0, Driver: devpce_
Feb 14 07:15:13 2E:csd savecore: pb 17: PCI E
Feb 14 07:15:13 2E:csd savecore: pb 18: <0>PANIC: KERNEL FAULT
Feb 14 07:15:13 2E:csd savecore: pb 19: PC: 0x800789b0 ep: 0xffffc728
Feb 14 07:15:13 2E:csd savecore: pb 20: EXC code:128, `Software detected SEGV '
Feb 14 07:15:13 2E:csd savecore: pb 21: Bad addr: 0x0, cause: 0x8<CE=0,EXC=RMISS>
Feb 14 07:15:13 2E:csd savecore: pb 22: sr: 0x8403<IM8,IM3,IPL=6,MODE=KERNEL,EXvg^C^?^?v_^C^?^?vW^C^?^?vO^C^?^?vG^C at block 0, space:
0x7fbc pages
```



```
Feb 14 07:15:13 2E:csd savecore: System went down at Tue Feb 13 16:26:29 2001
Feb 14 07:15:14 5E:csd savecore: saving 113590272 bytes of image in /var/adm/crash/vmcore.41.comp
Feb 14 07:16:05 1D:csd mediad: couldn't find DSO for device at SCSI ctlr 1, id 3
Feb 14 07:16:06 6D:csd dmb[828]: started
```

The error reported is: `PCI Error: Bus 2, Slot 6, Function 0, Driver: devpce_`

This error indicates a failure on the Mercury System card. The replacement of the Mercury System card did not resolve the problem. Replacing the RACEway cable (connecting the SYTEM card to the PCILK card) corrected the failure.

Example #2:

Problem Description:

At login there are panic messages on the screen:

```
PANIC: KERNEL FAULT
PC: 0x800789b0 ep:0xffffc728
.
.
.
.
SAVECORE :SAVING 113590272 bytes or image in /var/adm/crash/vmcore.66.comp
```

(press reset to restart the machine.)

Troubleshooting steps:

1. Reset the O2.
2. Login as **guest** (password **letmein**).
3. Open a Unix shell window
4. Type: **hinv and press <enter>.**

The **hinv** output is as follows:

```
csd 1# hinv
Video: MVP unit 0 version 1.4
 with no AV Card or Camera.
FLASH PROM version 4.12
```

```
On-board serial ports: 2
On-board EPP/ECP parallel port
1 200 MHZ IP32 Processor
FPU: MIPS R5000 Floating Point Coprocessor Revision: 1.0
CPU: MIPS R5000 Processor Chip Revision: 2.1
Data cache size: 32 Kbytes
Instruction cache size: 32 Kbytes
Secondary unified instruction/data cache size: 1 Mbyte on Processor 0
Main memory size: 256 Mbytes
Iris Audio Processor: version A3 revision 0
Integral Ethernet: ec0, version 1
  Optical disk: unit 3 on SCSI controller 1
  CDROM: unit 4 on SCSI controller 0
  Disk drive: unit 1 on SCSI controller 0
CRM graphics installed
Mass Storage PCI: Bus 3, Slot 7, Function 0, Vendor ID 0x1134, Device ID 0x1    No driver
Unknown Type PCI: Bus 3, Slot 6, Function 0, Vendor ID 0x10b5, Device ID 0x906d No driver
Mass Storage PCI: Bus 3, Slot 4, Function 0, Vendor ID 0x1134, Device ID 0x1    No driver
Mass Storage PCI: Bus 2, Slot 6, Function 0, Vendor ID 0x1134, Device ID 0x1    No driver
Bit3 PCI Bridge Card: Bus 2, Slot 4
Bit3 PCI Bridge Card: Bus 1, Slot 4
Bit3 PCI Bridge Card: Bus 0, Slot 3
Integral SCSI controller 1: Version ADAPTEC 7880
Integral SCSI controller 0: Version ADAPTEC 7880
```

Vice: TRE

NOTE:

The ACQ card is missing. The **hinv** output should have included the line:

```
Unknown Type PCI: Bus 2, Slot 7, Function 0, Vendor ID 0x10b5, Device ID 0x906e No driver
```

The System boot-up data can be viewed by viewing the monitor during boot-up and also in the /var/adm/SYSLOG file. Remember the CIB and three PCI Bridge cards are not reported in the SYSLOG file.

Contents of the SYSLOG file:

```
Feb 27 10:41:56 6F:csd syslogd: restart
Feb 27 10:41:56 2A:csd unix: IRIX Release 6.3 IP32 Version 12161207 System V
Feb 27 10:41:56 2A:csd unix: Copyright 1987-1996 Silicon Graphics, Inc.
Feb 27 10:41:56 2A:csd unix: All Rights Reserved.
Feb 27 10:41:56 2A:csd unix:
Feb 27 10:41:56 2A:csd unix: devpce_init: start registration
Feb 27 10:41:56 2A:csd unix: devpce_attach: vhdl=0x80881650.
Feb 27 10:41:56 2A:csd unix: devpce_attach: my_device_info=0x8088166c.
Feb 27 10:41:56 2A:csd unix: devpce_attach: cfg_addr = 0x80023000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_0 = 0xc0006000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_1 = 0xc4006000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_2 = 0xb8001000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_3 = 0xc5006000
Feb 27 10:41:56 2A:csd unix: devpce_attach: vendor_id = 0x1134
Feb 27 10:41:56 2A:csd unix: devpce_attach: vendor_device_id = 0x1
Feb 27 10:41:56 2A:csd unix: devpce_attach: int_handle = 0x8088172c
Feb 27 10:41:56 2A:csd unix: devpce_attach: bus number = 0x2
Feb 27 10:41:56 2A:csd unix: devpce_attach: device number = 0x6
Feb 27 10:41:56 2A:csd unix: devpce_attach: function number = 0x0
Feb 27 10:41:56 2A:csd unix: devpce_attach: adding minor number = 0
Feb 27 10:41:56 2A:csd unix: devpce_attach: setting up global buffer for host SMBs
Feb 27 10:41:56 2A:csd unix: devpce_attach: my_global_buf_size 0xe00000
Feb 27 10:41:56 2A:csd unix: devpce_attach: os__host_buffer_status 0x1
Feb 27 10:41:56 2A:csd unix: devpce_attach: os__host_buffer_ptr = 0xa088f000
Feb 27 10:41:56 2A:csd unix: devpce_attach: *os__host_buffer_ptr = 0x0
Feb 27 10:41:56 2A:csd unix: devpce_attach: host buffer initialized
Feb 27 10:41:56 2A:csd unix: devpce_attach: vhdl=0x80881748.
Feb 27 10:41:56 2A:csd unix: devpce_attach: my_device_info=0x80881764.
Feb 27 10:41:56 2A:csd unix: devpce_attach: cfg_addr = 0x80032000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_0 = 0xc5106000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_1 = 0xc6106000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_3 = 0xca106000
Feb 27 10:41:56 2A:csd unix: devpce_attach: vendor_id = 0x1134
Feb 27 10:41:56 2A:csd unix: devpce_attach: vendor_device_id = 0x1
Feb 27 10:41:56 2A:csd unix: devpce_attach: int_handle = 0x80881824
Feb 27 10:41:56 2A:csd unix: devpce_attach: bus number = 0x3
Feb 27 10:41:56 2A:csd unix: devpce_attach: device number = 0x4
Feb 27 10:41:56 2A:csd unix: devpce_attach: function number = 0x0
Feb 27 10:41:56 2A:csd unix: devpce_attach: adding minor number = 1
Feb 27 10:41:56 2A:csd unix: devpce_attach: vhdl=0x80881840.
Feb 27 10:41:56 2A:csd unix: devpce_attach: my_device_info=0x8088185c.
Feb 27 10:41:56 2A:csd unix: devpce_attach: cfg_addr = 0x80033800
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_0 = 0xc8106000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_1 = 0xc9106000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_3 = 0xca206000
Feb 27 10:41:56 2A:csd unix: devpce_attach: vendor_id = 0x1134
Feb 27 10:41:56 2A:csd unix: devpce_attach: vendor_device_id = 0x1
Feb 27 10:41:56 2A:csd unix: devpce_attach: int_handle = 0x80881928
Feb 27 10:41:56 2A:csd unix: devpce_attach: bus number = 0x3
Feb 27 10:41:56 2A:csd unix: devpce_attach: device number = 0x7
Feb 27 10:41:56 2A:csd unix: devpce_attach: function number = 0x0
Feb 27 10:41:56 2A:csd unix: devpce_attach: adding minor number = 2
Feb 27 10:41:56 2A:csd unix: devpce_attach: vhdl=0x80881980.
Feb 27 10:41:56 2A:csd unix: devpce_attach: my_device_info=0x8088199c.
Feb 27 10:41:56 2A:csd unix: devpce_attach: cfg_addr = 0x80033000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_0 = 0xca306000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_1 = 0xb8002000
Feb 27 10:41:56 2A:csd unix: devpce_attach: base_addr_2 = 0xc7106000
Feb 27 10:41:56 2A:csd unix: devpce_attach: vendor_id = 0x10b5
Feb 27 10:41:56 2A:csd unix: devpce_attach: vendor_device_id = 0x906d
Feb 27 10:41:56 2A:csd unix: devpce_attach: int_handle = 0x80881a68
Feb 27 10:41:56 2A:csd unix: devpce_attach: bus number = 0x3
Feb 27 10:41:56 2A:csd unix: devpce_attach: device number = 0x6
Feb 27 10:41:56 2A:csd unix: devpce_attach: function number = 0x0
Feb 27 10:41:56 2A:csd unix: devpce_attach: adding minor number = 3
Feb 27 10:41:56 2A:csd unix: devpce_init: end registration
Feb 27 10:41:56 5A:csd unix: NOTICE: Start mounting filesystem: /
Feb 27 10:41:56 5A:csd unix: NOTICE: Starting XFS recovery on filesystem: / (dev: 128/16)
Feb 27 10:41:56 5A:csd unix: NOTICE: Ending XFS recovery for filesystem: / (dev: 128/16)
Feb 27 10:41:56 3D:csd inetd[243]: /usr/etc/rpc.mountd: No such file or directory
Feb 27 10:41:56 3D:csd last message repeated 3 times
Feb 27 10:41:56 3D:csd inetd[243]: /usr/etc/rpc.rwalld: No such file or directory
Feb 27 10:41:56 3D:csd inetd[243]: /usr/etc/rpc.rusersd: No such file or directory
Feb 27 10:41:56 3D:csd inetd[243]: /usr/etc/rpc.rquotad: No such file or directory
Feb 27 10:41:56 3D:csd inetd[243]: /usr/etc/rpc.sprayd: No such file or directory
Feb 27 10:41:56 3D:csd inetd[243]: /usr/etc/rpc.bootparamd: No such file or directory
Feb 27 10:42:05 1D:csd mediad: couldn't find DSO for device at SCSI ctlr 1, id 3
Feb 27 10:42:05 6D:csd dmb[709]: started
csd 10# jot
csd 11#
```

NOTE:

This (24sharc) system SYSLOG only reported “adding minor number = 3”. “Adding minor number = 4” should have been reported on this 24sharc system

By examining the above SYSLOG we can determine the Acquisitor card is missing.

The SYSLOG should have included the following 2 lines:

```
devpce_attach: bus number = 0x2
devpce_attach: device number = 0x7
```

NOTE:

The SYSLOG does not report the presence of the CIB or the three PCI Bridge locations.

DMC Diagnostic (using Mercury Commands)

This test is almost identical to the DMC test in nominal diagnostics. The main difference is the SCSI Disk Transfer test which yields results (see page *2-165*). Use this test instead of, or in addition to, the DMC test in nominal diagnostics.

NOTE:

If memory problems are encountered in expansion cards, this DMC test can successfully locate them.

DMC Diagnostic

- More detailed than the DMC test accessible through the Diagnostic icon on the main login screen.
- This version of the DMC test can be performed on a specific CE or all CE’s (sharcs).
- Ability to configure tests for individual CE’s.
- Useful for locating bad CE’s, indicating a bad Mercury card(s).

Tests

- Incremental check of each sharc (CE)
- Data pattern is transferred between every 4 sharcs (CN)
- RACEway (bus) integrity between all cards
- Writing from sharc to sharc through the RACEway bus
- The first CE of each CN writes to the expansion memory
- Loop back test for SCSI communication verification (system card)
- Write/Read to SCSI disk Sector 0

> **NOTE:**
>
> "./ResetMercury" must be performed prior to running the test. If the reset fails, the test cannot be performed.

Text Conventions

The **green** text includes questions to answer to continue with the DMC test. The blue line is useful data. During the first phase of the test the first CE (computer element or sharc) of each CN (computer node) is tested e.g. CE's 2,6,10,14,18 and 22.

DMC Test Procedure

1. From the main login screen login as **root** (password: **pkserv99**).
2. Open a Unix shell window
3. Type: **cd /** and press **<Enter>**.
   Type: **source /usr/diamond.root/Scripts/diamondsetvars** and press **<Enter>**.
   Type: **cd /usr/diamond.root/IRSbin** and press **<Enter>**.
   Type: **./ResetMercury** and press **<Enter>**.
   Type: **dmc –cn=40 –lf=0** and press **<Enter>**.

   Or for a 16 sharc IRS type: **dmc –cn=34 –lf=0** and press **<Enter>**.

> **NOTE:**
>
> There is a space after **dmc** and after **40 (34)**.

4. Follow the instructions on the screen.

DMC Sample Test Results

The following example was performed on a 24sharc configuration. After entering the **dmc** command, the following output appeared on the screen:

```
                   DMC, rev 7.3.2
          Copyright 1990 - 1999, Mercury Computer Systems, Inc.
        ************* Configuration Info *************
BOARD          CE TYPE /   MEMORY
TYPE    CE ID  DEVICE      SIZE     ILK CONNECTION
------  -----  ----------  ------   --------------
SYSTEM                             ILK ID 1, Port 5
        2      RACE_2106x  32M
        3      RACE_2106x  32M
        4      RACE_2106x  32M
        5      RACE_2106x  32M
        6      RACE_2106x  32M
        7      RACE_2106x  32M
        8      RACE_2106x  32M
        9      RACE_2106x  32M
EXPANS                             ILK ID 1, Port 5
               RACE_ZMOD
        10     RACE_2106x  32M
        11     RACE_2106x  32M
        12     RACE_2106x  32M
        13     RACE_2106x  32M
        14     RACE_2106x  32M
        15     RACE_2106x  32M
        16     RACE_2106x  32M
        17     RACE_2106x  32M
EXPANS                             ILK ID 1, Port 5
               RACE_ZMOD
        18     RACE_2106x  32M
        19     RACE_2106x  32M
        20     RACE_2106x  32M
        21     RACE_2106x  32M
        22     RACE_2106x  32M
        23     RACE_2106x  32M
        24     RACE_2106x  32M
        25     RACE_2106x  32M
Is this configuration correct (<y>/n) ? y
Do you want to run the Host-Based Tests (<y>/n) ? y
```

NOTE:

Answer “**Yes**” to these 2 questions. Answering “**No**” for the second one terminates the DMC test.

```
Running Host-Based Memory Tests on CEID 22 ...Passed.
Loading ...Done.
Verifying communication with CEID 25.

        ****************** Main Menu ******************

1 - Begin Testing
2 - Edit the Test Selections
3 - Go to the Test Environment Menu
4 - Edit the System Configuration
5 - Exit to the Operating System
```

The following is an example how to edit Test Selections for testing CE#2 with SCSI disk transfer. (If you don’t edit tests, this is not tested)

```
1 - Begin Testing.
2 - Edit the Test Selections.
3 - Go to the Test Environment Menu.
4 - Edit the System Configuration.
5 - Exit to the Operating System.

Please Enter Choice(1-5): 2
```

NOTE:

You have chosen to display or change the test menu(s), Next, you must select which CE(s) to test.

```
BOARD           CE TYPE /   MEMORY
TYPE    CE ID   DEVICE      SIZE     ILK CONNECTION
------  -----   ----------  ------   --------------
SYSTEM                              ILK ID 1, Port 5
        2       RACE_2106x  32M
        3       RACE_2106x  32M
        4       RACE_2106x  32M
        5       RACE_2106x  32M
        6       RACE_2106x  32M
        7       RACE_2106x  32M
        8       RACE_2106x  32M
        9       RACE_2106x  32M
EXPANS                              ILK ID 1, Port 5
                RACE_ZMOD
        10      RACE_2106x  32M
        11      RACE_2106x  32M
        12      RACE_2106x  32M
        13      RACE_2106x  32M
        14      RACE_2106x  32M
        15      RACE_2106x  32M
        16      RACE_2106x  32M
        17      RACE_2106x  32M
EXPANS                              ILK ID 1, Port 5
                RACE_ZMOD
        18      RACE_2106x  32M
        19      RACE_2106x  32M
        20      RACE_2106x  32M
        21      RACE_2106x  32M
        22      RACE_2106x  32M
        23      RACE_2106x  32M
        24      RACE_2106x  32M
        25      RACE_2106x  32M

Enter CEID Number(s) (2,...,25 or 2-25): 2
```

> **NOTE:**
>
> This menu only displays the tests supported by your hardware configuration. Test numbers that do not appear are not applicable - selecting them will have no effect.

```
  Test Selection Menu for CEID 2 (S = Selected, D = Deselected)
    -----------------------------------------------------------
    S/D #  Test                              S/D #  Test
                    *** LOCAL CE PHASE ***
     S  1 Memory Tests                        S  2 Timer Test
                    *** ZCE PHASE ***
     S  3 ZBUS Broadcast Test
                    *** XBAR/ILK PHASE ***
     S  4 Core Processor XBAR Test            S  5 DMA XBAR Test
                    *** ZMOD PHASE ***
     S  6 Memory Only Device Test
                    *** SCSI PHASE ***
     S  7 SCSI Loopback                       D  8 SCSI Disk Transfer

Do you want to SELECT tests, DESELECT tests or CONTINUE (s/d/c)? s
Enter Test Number(s) (1,...,8 or 1-8): 1-8
```

> **NOTE:**
>
> This is the default test setting. The current selection includes the SCSI Disk Transfer test as seen below.

```
Test Selection Menu for CEID 2 (S = Selected, D = Deselected)
    -----------------------------------------------------------
    S/D #  Test                             S/D #  Test
                      *** LOCAL CE PHASE ***
     S  1 Memory Tests                       S  2 Timer Test
                      *** ZCE PHASE ***
     S  3 ZBUS Broadcast Test
                      *** XBAR/ILK PHASE ***
     S  4 Core Processor XBAR Test           S  5 DMA XBAR Test
                      *** ZMOD PHASE ***
     S  6 Memory Only Device Test
                      *** SCSI PHASE ***
     S  7 SCSI Loopback                      S  8 SCSI Disk Transfer

Do you want to SELECT tests, DESELECT tests or CONTINUE (s/d/c): c

        ****************** Main Menu ******************

1 - Begin Testing
2 - Edit the Test Selections
3 - Go to the Test Environment Menu
4 - Edit the System Configuration
5 - Exit to the Operating System

Please Enter Choice(1-5): 1
```

NOTE:

This is the status display while the tests are running. The status line will only be updated in the event that one of the CE's status changes.

```
Starting the LOCAL CE PHASE.
 0 Devices Running, 24 Devices Passed,  0 Devices Failed
All Devices Passed this Phase.

Starting the ZCE PHASE.
 0 Devices Running, 24 Devices Passed,  0 Devices Failed
All Devices Passed this Phase.

Starting the XBAR PHASE.
 0 Devices Running, 24 Devices Passed,  0 Devices Failed
All Devices Passed this Phase.

Starting the MOD PHASE.
 0 Devices Running, 24 Devices Passed,  0 Devices Failed
All Devices Passed this Phase.

Starting the SCSI PHASE.
   CEID   2:  LUN 1: SEAGATE ST34371W         Rev:0484 Wide:1 TCQ:1 Sync:1
   CEID   2:  Last block = 8517376, Block size = 512
   CEID   2:  LUN 2: SEAGATE ST34371W         Rev:0484 Wide:1 TCQ:1 Sync:1
   CEID   2:  Last block = 8517376, Block size = 512
   CEID   2:  LUN 3: SEAGATE ST34371W         Rev:0484 Wide:1 TCQ:1 Sync:1
   CEID   2:  Last block = 8517376, Block size = 512
   CEID   2:  LUN 4: SEAGATE ST34371W         Rev:0484 Wide:1 TCQ:1 Sync:1
   CEID   2:  Last block = 8517376, Block size = 512
 0 Devices Running, 24 Devices Passed,  0 Devices Failed
All Devices Passed this Phase.
```

NOTE:

The green lines were output after the test finished.

Example of a DMC Test Failure

```
Running Host-Based Memory Tests on CEID 2 ...
The Host-Based Cell test failed on CEID 2
The address = 55c9b8
The expected data = 5a5a5a5a, the actual data = a5a5a5a5
Running Host-Based Memory Tests on CEID 22 ...Passed.
Loading ...Done.
Verifying communication with CEID 25.
```

In this example, the testing of CE #2 failed (shown in blue) (Mercury System Card).

System and Expansion Card Jumper Settings

This section describes the jumper settings for both system and expansion cards in the IRS.

Note that there are two revisions for both cards. The jumper settings for the old and new revisions are listed in the tables below.

⚠ CAUTION

THE JUMPERS EMPHASIZED WITH SHADING ARE TO BE CONFIGURED DIFFERENTLY FOR 24 OR 16 SHARCS. ALL OTHER JUMPERS SHOULD BE LEFT AS SUPPLIED BY THE VENDOR.

The new revision cards can be mixed with old revision cards in the IRS crate.

NOTE:

No jumpers are needed for the new PCILK card.

System Card D1 (Old Revision 900-07010)

Table 2-5: System Card D1 (Old Revision 900-07010)—Jumper Settings

JUMPER	USE OF THE JUMPER	WITH 24 SHARCS	WITH 16 SHARCS	PXB EEPROM PROGRAMMING
W1	Clock Source (In = Master)	OUT	IN	IN
W2	PXB loading source (out=load from eeprom)	IN	IN	----
W3	Drive Clock on JX1 (In = Drive the clock)	OUT	IN	----
W4	Drive Clock on JX2 (In = Drive the clock)	OUT	OUT	----
J100	Clock33 1-2 = enable , 2-3 = Gnd	1-2	1-2	----
J101	Daughter card attached (Its for JTAG only, out=yes)	OUT	OUT	----

NOTE:

With 16 Sharcs—Clock is supplied to both cards by System Card via JX1.
With 24 Sharcs—Clock is supplied by PCILK Card. (Inter Link Card).

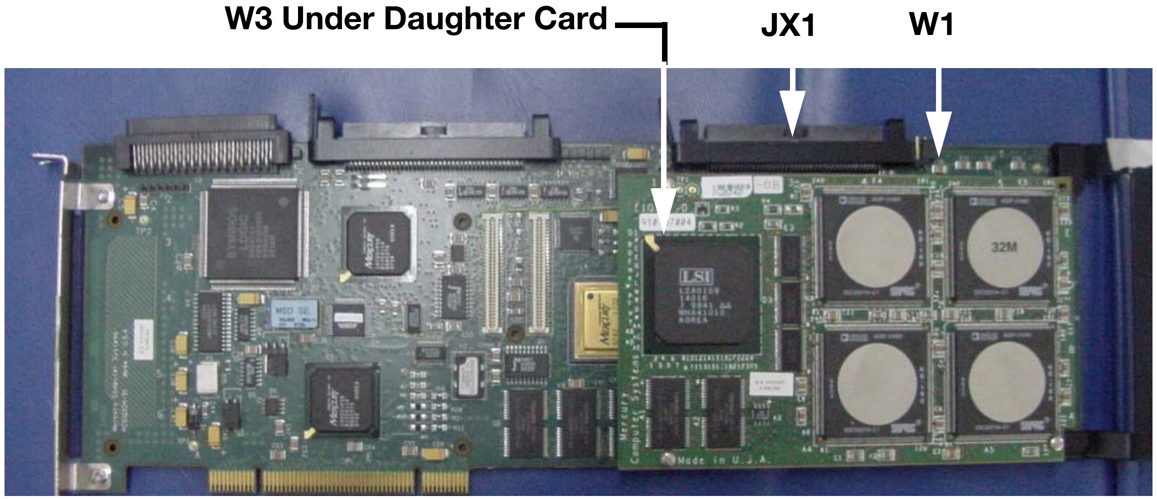

W3 Under Daughter Card
JX1
W1

Figure 2-58: Old Revision System Card

Expansion Card D2 (Old Revision 900-07022)

Table 2-6: Expansion Card D2 (Old Revision 900-07022)——Jumper Settings

JUMPER	USE OF THE JUMPER	WITH 24 SHARCS	WITH 16 SHARCS	PXB EEPROM PROGRAMMING
W1	Factory setting	OUT	OUT	OUT
W2	PXB Loading source (out=load from eeprom)	OUT	OUT	OUT
W6	Clock Source (In = Master)	OUT	OUT	IN

NOTE:

During programming, the system card is not installed and the clock is internally supplied by the expansion board (W6 = In)

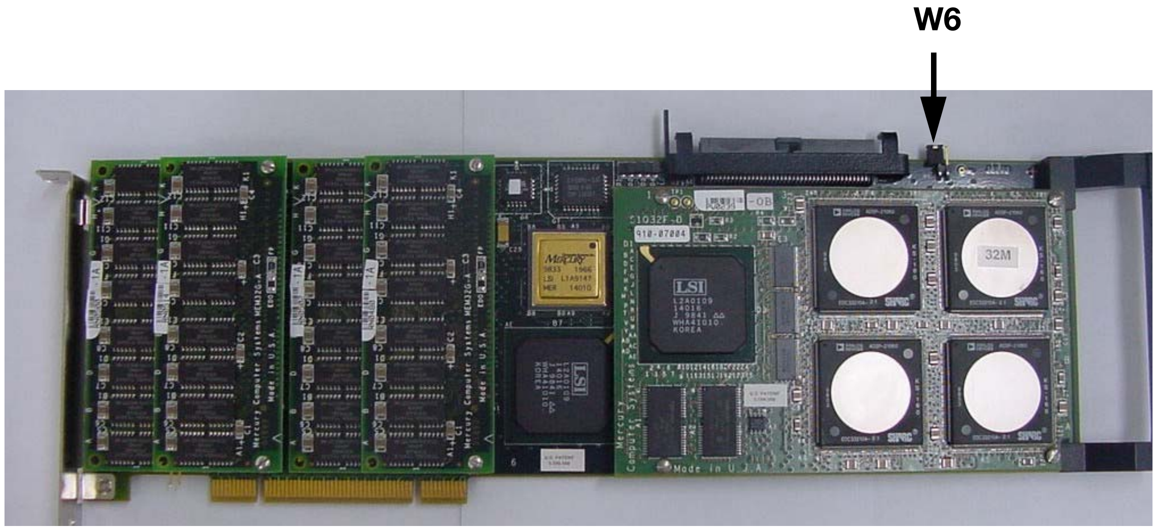


Figure 2-59: Old Revision Expansion Card

System Card D1 (New Revision)

Table 2-7: System Card D1 (New Revision)—Jumper Settings

JUMPER	USE OF THE JUMPER	WITH 24 SHARCS	WITH 16 SHARCS	PXB EEPROM PROGRAMMING
W1	Clock40 Source (In = Master)	OUT	IN	IN
W2	PXB Loading Source (out = load from eeprom)	IN	IN	----
W3	Drive Clock40 on JX1 (In = Drive the clock)	OUT	IN	----
W4	Drive Clock40 on JX2 (In = Drive the clock)	OUT	OUT	----
W6	Reset Board (In = Reset)	OUT	OUT	----
W500	Xbar++ Loading Source (out= load from EEprom)	OUT	OUT	----
W501	Xbar++ EEprom Write Protect (out = protected)	OUT	OUT	----
W502	Xbar++ Register (out = access)	OUT	OUT	----
J100	Clock33 1-2 = enable , 2-3 = Gnd	1-2	1-2	----
J101	Daughter card attached (Its for JTAG only , out=yes)	OUT	OUT	----

NOTE:

No Programming is needed on System Board (Only on Expansions)
Memory buffer of system card should be 64 MB.

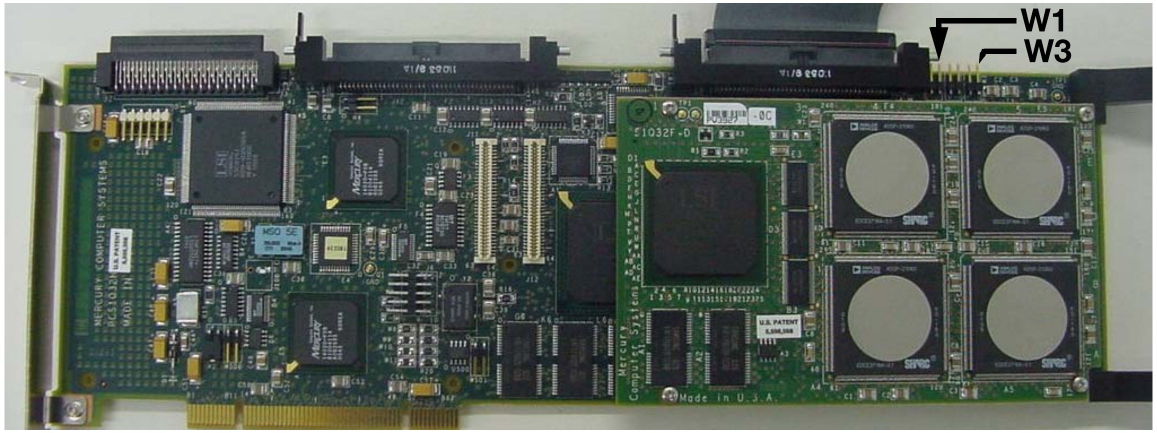


Figure 2-60: System Card D1 (New Revision)

Expansion Card D2 (New Revision)

Table 2-8: Expansion Card D2 (New Revision)—Jumper Settings

JUMPER	USE OF THE JUMPER	WITH 24 SHARCS	WITH 16 SHARCS	PXB EEPROM PROGRAMMING
W2	PXB Loading Source (out = load from eeprom)	OUT	OUT	OUT
W3	Xbar++ EEprom Write Protect (out = protected)	OUT	OUT	OUT
W6	Clock40 Select (In = Master)	OUT	OUT	IN
W7	Drive clock On J1 (IN = Drive the Clock)	OUT	OUT	OUT
W8	Xbar++ Loading Source (out= load from EEprom)	OUT	OUT	OUT
W9	Xbar++ Register (out = access)	OUT	OUT	OUT

NOTE:

The new expansion board must always be programmed to memory buffer of 16 MB.

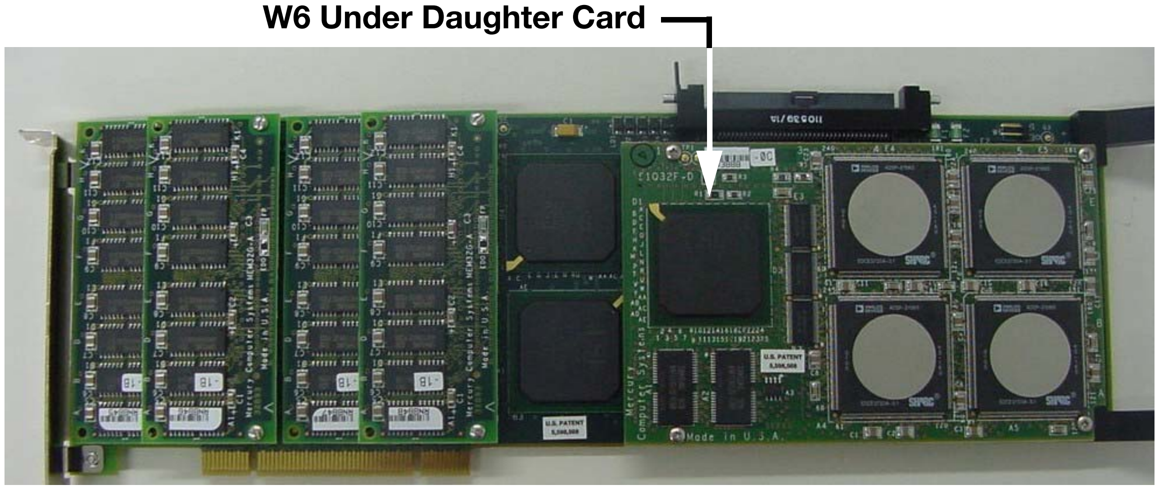


Figure 2-61: Expansion Card D2 (New Revision)

PCI Link Card

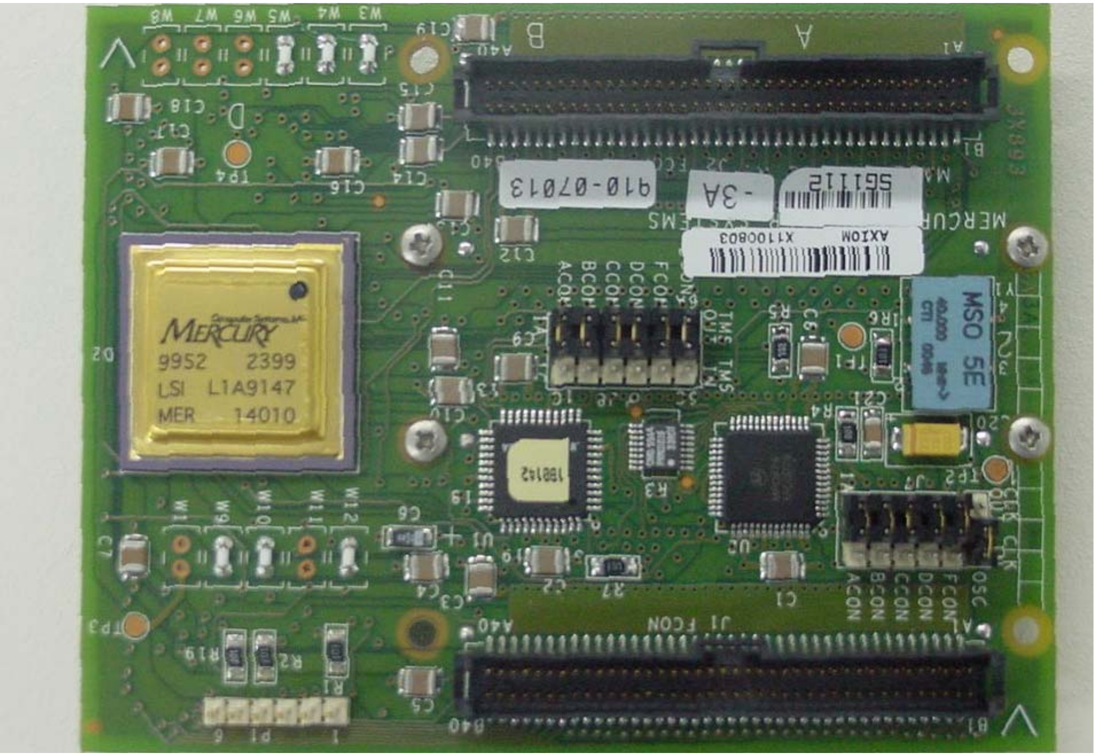

MERCURY
9952 2399
LSI L1A9147
MER 14010
910-07013
-3A
AXIOM
X1100803
MSO 5E

Figure 2-62: Old Revision PCI Link Card

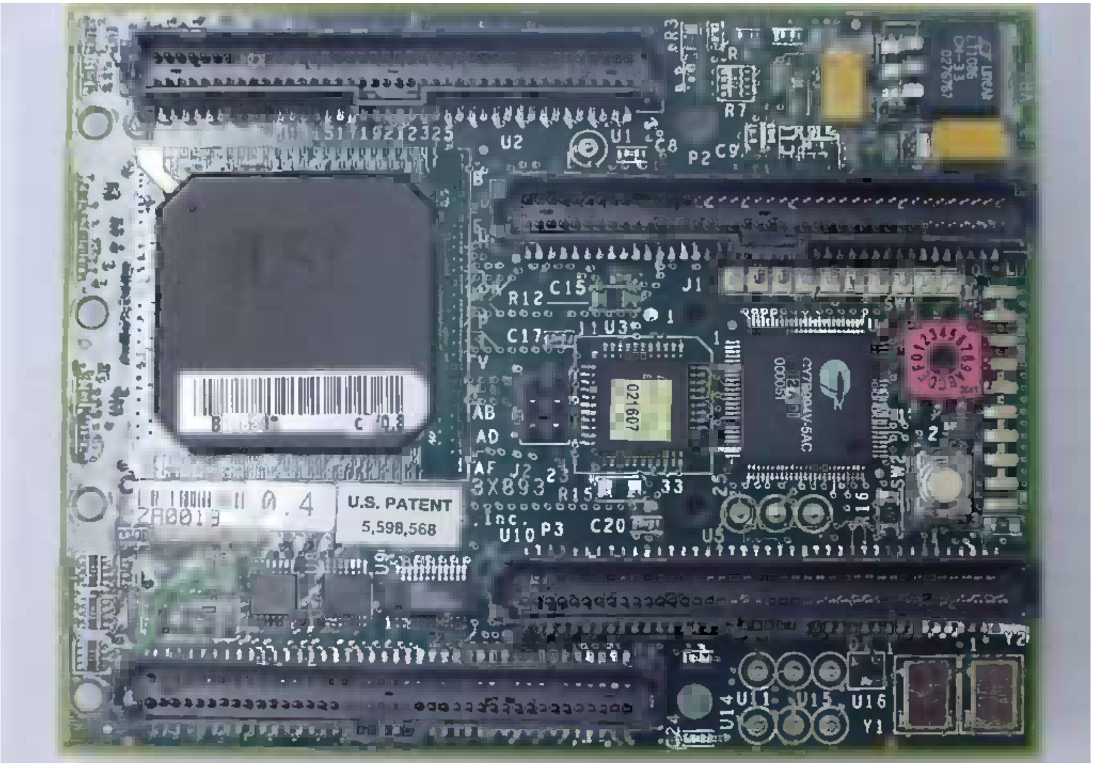


Figure 2-63: New Revision PCI Link Card

Chapter 3
Gantry

System Control 3-1

System/MCB 3-1
System/CAN 3-4
CAN 3-5
System/Hardwired Signals 3-6

Slip Ring Assembly 3-7

Overview 3-7
Functional Description 3-9
  Serial Data Signals 3-9
  Error Signals 3-10
  CAN and Stop-Report Signals 3-12

Gantry Stationary Overview 3-14

Components 3-14

Gantry Stationary Functional Description 3-16

Gantry Stationary Functions 3-16
  Rotation Overview 3-18
  Rotation Functions 3-20
  Gantry Tilt Overview 3-27
  Gantry Tilt Functions 3-30
  Gantry Cooling 3-37
  Patient Handling Control (PHC) 3-37
  Audio-Intercom 3-40
  X-Ray Control 3-42
  Patient Table Interface 3-44
  System Interface 3-46
  Power Supply Stationary 3-48
  Phases Description 3-50

Gantry Stationary Diagnostics and Troubleshooting 3-56

Testing the MCU_MCB Board 3-57
Testing the RTC_MCB Board 3-58
  Frequency Converter (FC) Interface Rotation Test 3-58
  Maximum Speed Limit Test 3-59
  Angle Pulse (AP) Test 3-60
  Frequency Converter (FC) Tilt Test 3-60
  Tilt Test 3-60
Testing the GPC Board 3-60
Verifying Correct Water Hose Connections in the Gantry 3-62
  Procedure 3-62
  Water Hose Replacement in Case of Incorrect Positioning 3-65
  Final Step 3-66

Gantry Stationary Parts Replacement 3-67

Overview 3-67
Left Side of the Gantry 3-68

Right Side of the Gantry 3-69
Replacing the Rotation Frequency Converter (E301) 3-72
Replacing the Tilt Sensor 3-75
Adjusting the Tilt Sensor 3-77
Replacing the Tilt Frequency Converter (E302) 3-79
Replacing the MCU RTC Board (D301) 3-81
Replacing the Tilt Spindle 3-83
Required Tools and Auxiliary Materials 3-83
Preliminary Steps 3-83
Removing the Tilt Spindle 3-85
Installing the Tilt Spindle 3-86
Cable Connections 3-87
Test and Adjustments 3-89
Final Steps 3-89
Replacing the Three-Way Valve 3-90
Replacing the GPC Board (D311) 3-92
Replacing the Dehumidifier 3-94
Replacing the Noise Cancellation Board (D344) 3-96
Replacing the Brake Assembly (E322) 3-98
Replacing the Transmitter and Receiver Boards 3-100
Replacing the Gantry Heat Exchanger 3-102
Replacing the Fan 3-104
Removal and Installation of the Funnel 3-107
Replacement and Adjustment of the Stator Laser Light Markers 3-109
Removal of the Laser Light Marker 3-109
Installing the New Laser Light Marker 3-110
Tests and Adjustments 3-110
Final Steps 3-111

Gantry Rotating Overview 3-112

Components 3-112
Gantry Rotating Functions 3-115

Gantry Rotating Functional Description 3-116

Focus Deflection 1 3-116
Overview 3-116
LEDs 3-119
Test Points 3-121
Signals 3-123
Focus Deflection 2 3-125
Overview 3-125
Signals 3-125
Z-Control 3-127
Overview 3-127
LEDs 3-127
Test points 3-129
Signals 3-131
A-Plane Collimation 3-132
Overview 3-132
LEDs 3-132
Test Points 3-135

Signals 3-137
P-Plane Collimation 3-138
Overview 3-138
Switches 3-139
LEDs 3-139
Test Point 3-141
Signals 3-141
Light Marker 3-142
Overview 3-142
Signals 3-142
Air Scan Compensator 3-144
Overview 3-144
LEDs 3-144
Signals 3-145
Ultra High Resolution (UHR) Collimator 3-147
Overview 3-147
Switches 3-147
LEDs 3-148
Signals 3-150
Tube Monitoring 3-151
Overview 3-151
Signals 3-151
Acquisition Control 1 3-154
Overview 3-154
Switches 3-155
LEDs 3-156
Signals 3-158
Acquisition Control 2 3-161
Signals 3-161
Communication Channels 3-163
Power Supply 3-165
DPU1 and DPU2 3-165
Power Supply ZCON 3-168
Power Supply DELPHI and DOM 3-170
Power Supply Tube Collimator Box 3-172

Gantry Rotating Diagnostics and Troubleshooting 3-174

Slip Ring Troubleshooting 3-174
Inhomogeneity and Damages to the Polyurethane (PU) 3-174
Rework Instruction for Pollution on Tracks 3-179
Further Possible Defects 3-180

Gantry Rotating Parts Replacement 3-182

Overview 3-182
Replacing the Tube Collimator (E555) 3-183
Preparations 3-183
The Tube Collimator Removal 3-184
Tube Collimator Installation 3-185
Final Steps 3-186
Replacing the PHI_Amp (D555) Board 3-187
Preparations 3-187

- PHI_Amp Board Removal 3-188
- PHI_Amp Board Installation 3-188
- Final Steps 3-189

Replacing the PHI_Z_MON (D554) Board 3-190
- Preparations 3-190
- PHI_Z_Mon Board Removal 3-191
- PHI_Z_Mon Board Installation 3-192
- Final Steps 3-192

Replacing Converter (C) Box Components 3-193
- Replacing the Back Plane of the C-Box (E510) 3-194
- Replacing the DPU_1 Board (E540) 3-199
- Removing the Old DPU_1 Board 3-200
- Installing the New DPU_1 Board 3-200
- Final Steps 3-200

Replacing the DPU_2 Board (E541) 3-201

Replacing the DELPHI Board (D515) 3-203

Replacing the Z_CON Board (D514) 3-205

Replacing the ACU Board (D513) 3-207

Replacing the Rotating Light Markers (E581-4) 3-209
- Preparations 3-210
- Removing the Old Light Marker 3-211
- Installing the New Light Marker 3-212
- Final Steps 3-212

DMS (Data Measurement System) 3-213

DMS Overview 3-213
- Detectors 3-218
- Gated Integrator (GI) Cards 3-221

RCOM Card 3-237
- DMS Temperature Control Cards 3-254

Lower Beam 3-256
- Overview 3-256
- P-Plane Collimator (Detector Diaphragm) 3-256
- Ultra High Resolution (UHR) Collimator 3-260

DMS Parts Replacement 3-263

ESD—Anti-Static Field Service Kit 3-264
- Purpose 3-264
- Tools 3-264
- Parts 3-264
- Procedure 3-266

Replacing Data Measurement System Components 3-272

Replacing the Complete DMS 3-273
- Introduction 3-273
- Parts List 3-274
- Unpacking the DMS Field Replacement Unit 3-276
- Disconnecting the Old DMS 3-277
- Removing the Old DMS 3-281
- Removing extra weights from the rotor 3-288
- Installing the New DMS 3-290
- Connecting the New DMS Unit 3-293
- Balancing the Rotor 3-294

  Entering New DMS Encoder Settings 3-294
  Mx8000 Physics Calibration 3-296
  Mx8000 Acceptance Test 3-296
  Image Noise Standard Deviation Checks 3-296
  Mx8000 Dual Physics Calibration 3-296
  Mx8000 Dual Acceptance Test 3-297
  Image Noise Standard Deviation Checks 3-297
Removing the Cover of the DMS 3-298
Replacing the Cradle Assembly 3-299
Replacing the P-Plane Motor 3-304
  Disassembly of the Old Motor 3-304
  Assembly of the New Motor 3-306
  Testing the Detector Collimator Movement—Examination of the Proper Functioning of the New Motor 3-307
Replacing the Encoder of the P-Plane 3-308
  Installing the New Encoder 3-308
  Calibrating P-Plane Stops 3-310
  Finding and Recording Hexadecimal Encoder Readings 3-311
P-Plane Collimator Host Table Set-up 3-315
  Validity 3-315
  Procedure 3-316
Replacing the Optical Switch of the P-Plane 3-318
Replacing the P-Plane Mylar 3-321
Replacing the Cradle Temperature Sensor 3-322
Replacing GI Cards 3-324
Replacing Detector Modules 3-326
Replacing the Cover Temperature Sensors 3-328
  Replacing the Left Temperature Sensor 3-328
  Replacing the Right Temperature Sensor 3-329
Replacing the DMS OFF Control Card 3-330
Replacing the Fan Power Distribution Board 3-331
Replacing the DMS Cover Fan 3-332

System Control

System/MCB

This block diagram shows the principle of the D2, Micro Controller and Base (MCB) hardware board. The board is used as the function controller of the different Mx8000 components. The MCB board is built of the components listed in *Table 3-1*.

Table 3-1: MCB Board Components

COMPONENT	DESCRIPTION
Controller	8 bit microcontroller, 16 MHz clock
CAN	CAN communications interface to connect the function controller to the CAN, Controller Area Network bus Via this path the communication to the Host or other function controller is done.
EPROM	EPROM memory of the microcontroller system firmware
RAM	RAM memory used as working memory
FEEPROM	FEEPROM, Flash Electrical EPROM Memory of the application firmware (e.g. for the ZCO, DLP, MCU, etc.) FEEPROM can be erased by the microcontroller using the signal Vppon, which switches on the Vpp=12 VDC supply. After that, new application firmware can be loaded from the Host WD.
Watchdog	To monitor the microcontroller firmware and Vcc
Stop Circuit	Stop Circuit is part of the Stop Report Loop of the Mx 8000 system. Every Function Controller is able to OPEN the System Stop Report Loop if an error is detected or a corresponding command is received. The Stop Report Loop is normally CLOSED, but is OPENED in any of the following cases: • The controller sets StopControl • The Watchdog is not triggered • The RESET push button is pressed

Table 3-1: MCB Board Components

COMPONENT	DESCRIPTION
StopRep Monitoring	The condition of the Stop Report Loop is monitored through the StopReport input signal of the Function Controller. If the System Stop Report Loop is CLOSED, the current through the opto-coupler sets the StopReport input signal to HIGH. If a System STOP occurs, the input signal is set to LOW. This falling edge is recognized by the controller, which sets itself into a non dangerous condition. If the Stop Report Loop is CLOSED again (rising edge) the controller starts a RESET (i.e. start address 0, output RESET, CAN_Comm RESET, etc.).
WHO	Since this Function Controller is used for different components in the system, the WHO lines tell the controller its location (e.g. DLP, MCU, ZCO, etc.).
AN	The Function Controller has an internal 12 channel data acquisition system. Via the AN inputs the Function Controller can measure or monitor up to 12 analog signals.
V24/TTL	V24/TTL is the interface which could be used to connect a PC to the Function Controller.

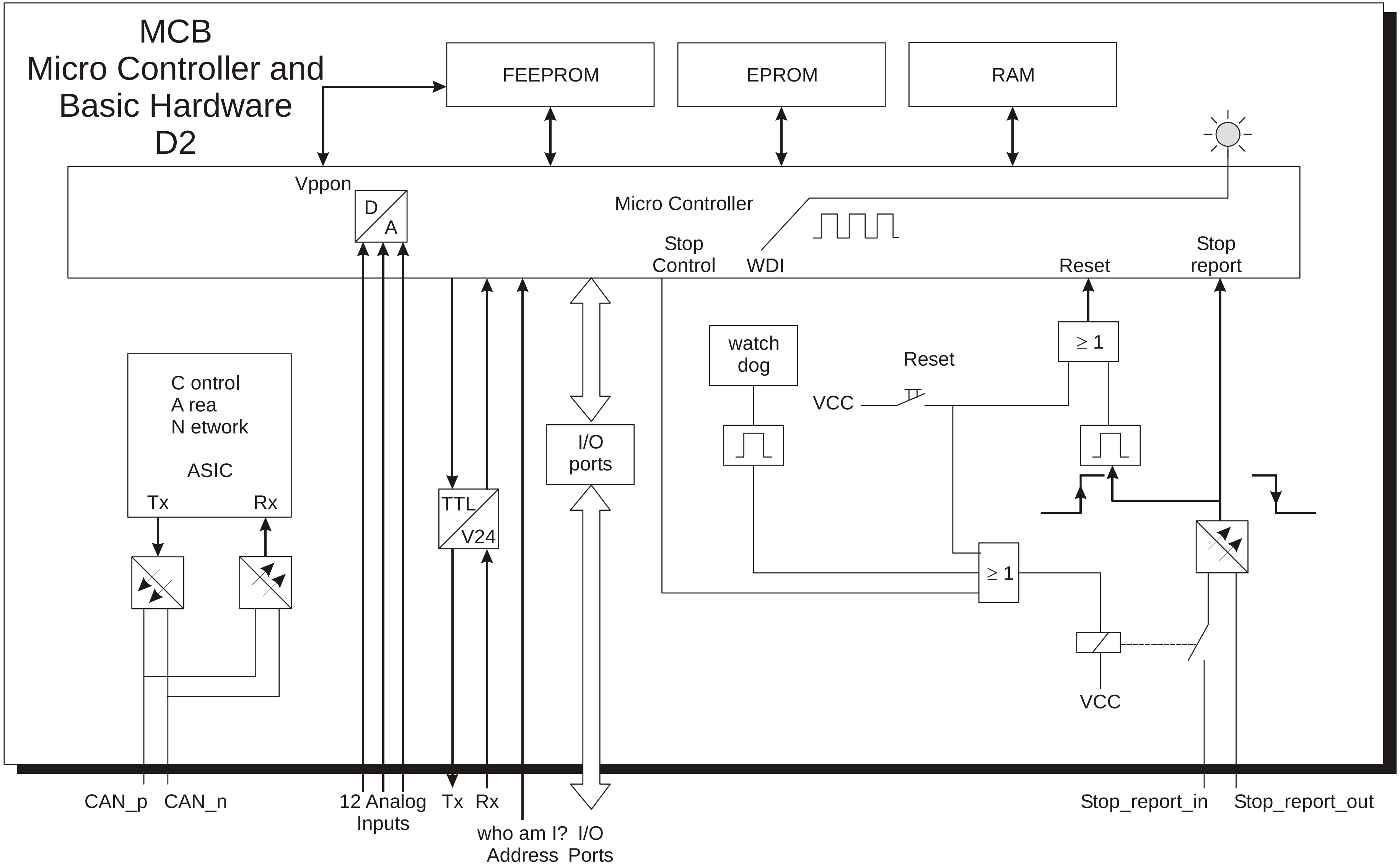

MCB
Micro Controller and
Basic Hardware
D2
FEEPROM
EPROM
RAM
Vppon
D
A
Micro Controller
Stop
Control
WDI
Reset
Stop
report
C ontrol
A rea
N etwork
ASIC
Tx
Rx
TTL
V24
I/O
ports
watch
dog
Reset
VCC
≥ 1
≥ 1
VCC
CAN_p
CAN_n
12 Analog
Inputs
Tx
Rx
who am I?
Address
I/O
Ports
Stop_report_in
Stop_report_out

Figure 3-1: MCB Overview-LEDs

System/CAN

System/CAN is an interconnection of several data processing systems or intelligent terminals that are called a data network.

Table 3-2:

COMPONENT	DESCRIPTION
Data network	Such kind of data network, as shown in the schematic, is built up of ten Function Controllers which are interconnected by a pair of wires. This network is called CAN, Controller Area Network. The block diagram shows the different controllers and their location within the Mx8000.
IRS	IRS-Imager Reconstruction System, CIB, CAN Interface Board
Gantry stationary	• MCU-Master Control Unit • RTC-Rotate Tilt Controller • GPC-Gantry Panel Control
PHS	• PTV-Patient Table Vertical • PTH-Patient Table Horizontal
PDC	DCC-Direct Current Circuit
Gantry rotating	• ACU-Acquisition Unit • ZCO-Z-Controller • DLP-Delphi Controller • DOM-Dose Modulation Controller
Generator	XRS-X-ray System Controller

CAN

The CAN connection is built up as a current loop. The two wires are labeled with **COMMPOS** and **COMMNEG**. The current source (approximately 40 mA) is on the D301 MCU-RTC in the Gantry Stationary. Every controller can interrupt this loop to send a message. Via this CAN, all necessary parameters and commands are distributed to assure safe operation.

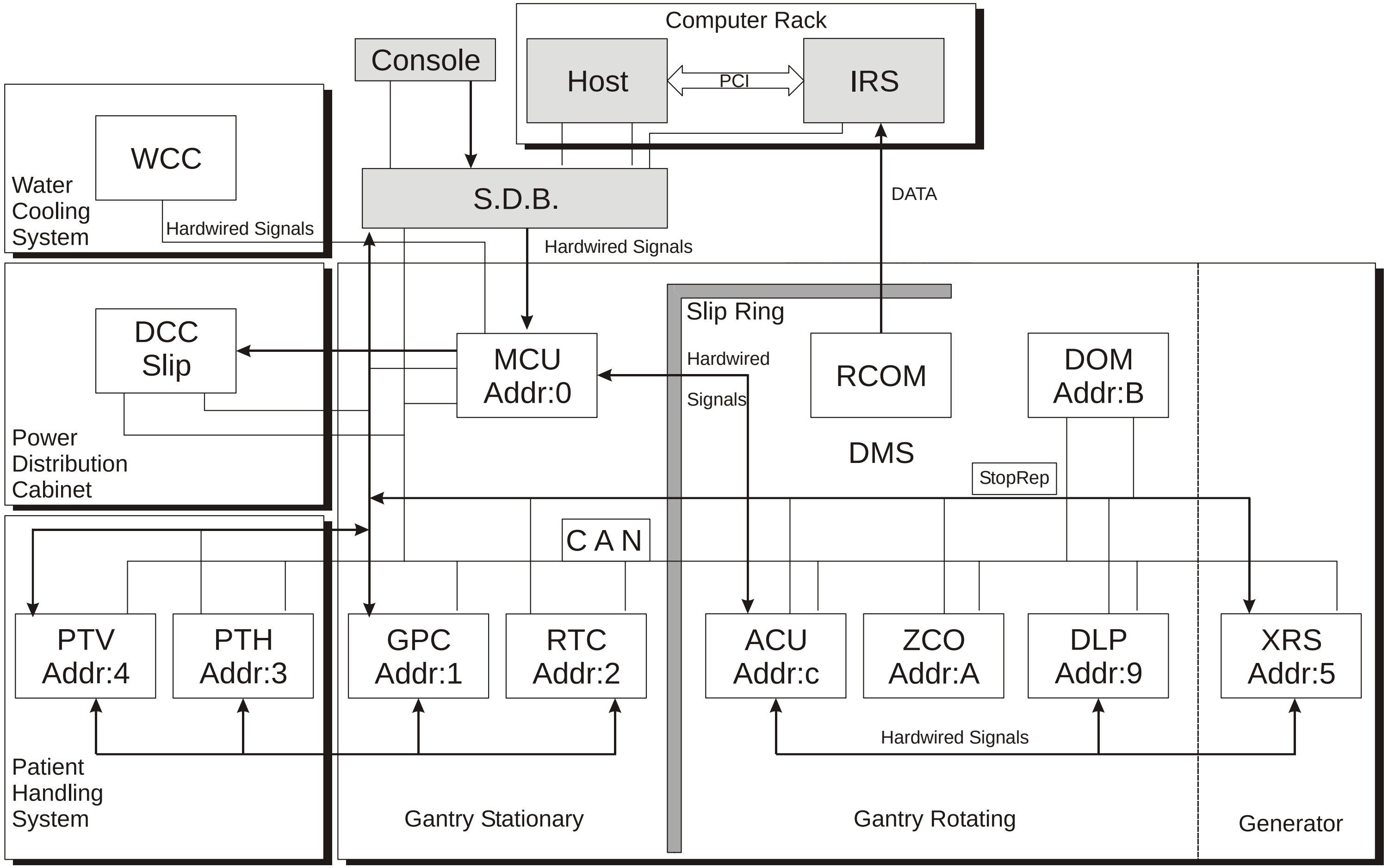

Computer Rack
Console
Host
PCI
IRS
WCC
Water Cooling System
Hardwired Signals
S.D.B.
DATA
Hardwired Signals
DCC Slip
Power Distribution Cabinet
MCU Addr:0
Slip Ring
Hardwired Signals
RCOM
DOM Addr:B
DMS
StopRep
CAN
PTV Addr:4
PTH Addr:3
GPC Addr:1
RTC Addr:2
ACU Addr:c
ZCO Addr:A
DLP Addr:9
XRS Addr:5
Hardwired Signals
Patient Handling System
Gantry Stationary
Gantry Rotating
Generator

Figure 3-2: System CAN-Controllers

System/Hardwired Signals

CAN does not operate in realtime. Therefore, hardwired signals (parallel to CAN) are connected between different Function Controllers and their hardware.

The following control signals and sources are used:

Table 3-3:

SOURCE	SIGNAL	DESCRIPTION
Console	START	Hardware scan start for the MCU connected via the SDB
ACU	XCENA, XC Enable	Signal to enable XCGen which is generated by the MCU
	EVENREA	(Even Reading) Indicator of an even reading number Used to synchronize the focus deflection with the data acquisition
	APO, AP90	Angular Pulses 0°, 90° and Index generated from light barriers to determine the actual rotation frame position
DLP	TUBE_ARC	(Tube Arcing) Indicator of tube arcing
	XRAY_ON/_A	(X-Ray On) If radiation is detected by the DLP controller, this signal is set
	FIL_DOSE	(Filament Dose) Analog feedback of the actual radiation intensity used for dose rate regulation and control
MCU	XCDENA_FW	(X-Ray Control Enable Firmware) Used together with XCENA_Rot to set the XCGen signal XCGen switches high voltage ON or OFF
XRS	XRAY	Acknowledgment signal if high voltage is on (Tube voltage >20 kV)
	DOSE_OK	(Dose Ok) This signal is set by the XRS controller if XRAY_ON is set and the XRS controller has changed to Dose Rate Control
PTH	HTP	(Horizontal Table Pulse) These pulses are used by the ACU controller to determine the actual table travel distance

Slip Ring Assembly

Overview

The Slip Ring Assembly transmits power, controls data and transfers data between the stationary and the rotating parts of the Gantry (see the block diagram in *Figure 3-3*).

Parts of the Slip Ring Assembly are located on both the stationary and rotating parts of the Gantry. The carbon brushes are on the stationary part of the Gantry. The slip rings are on the rotating part of the Gantry.

Measured data is transferred via capacitance slip rings and fiber optic cables.

The Slip Ring Assembly includes the following units:

- Power slip rings
- Control data slip rings
- Measured data slip rings

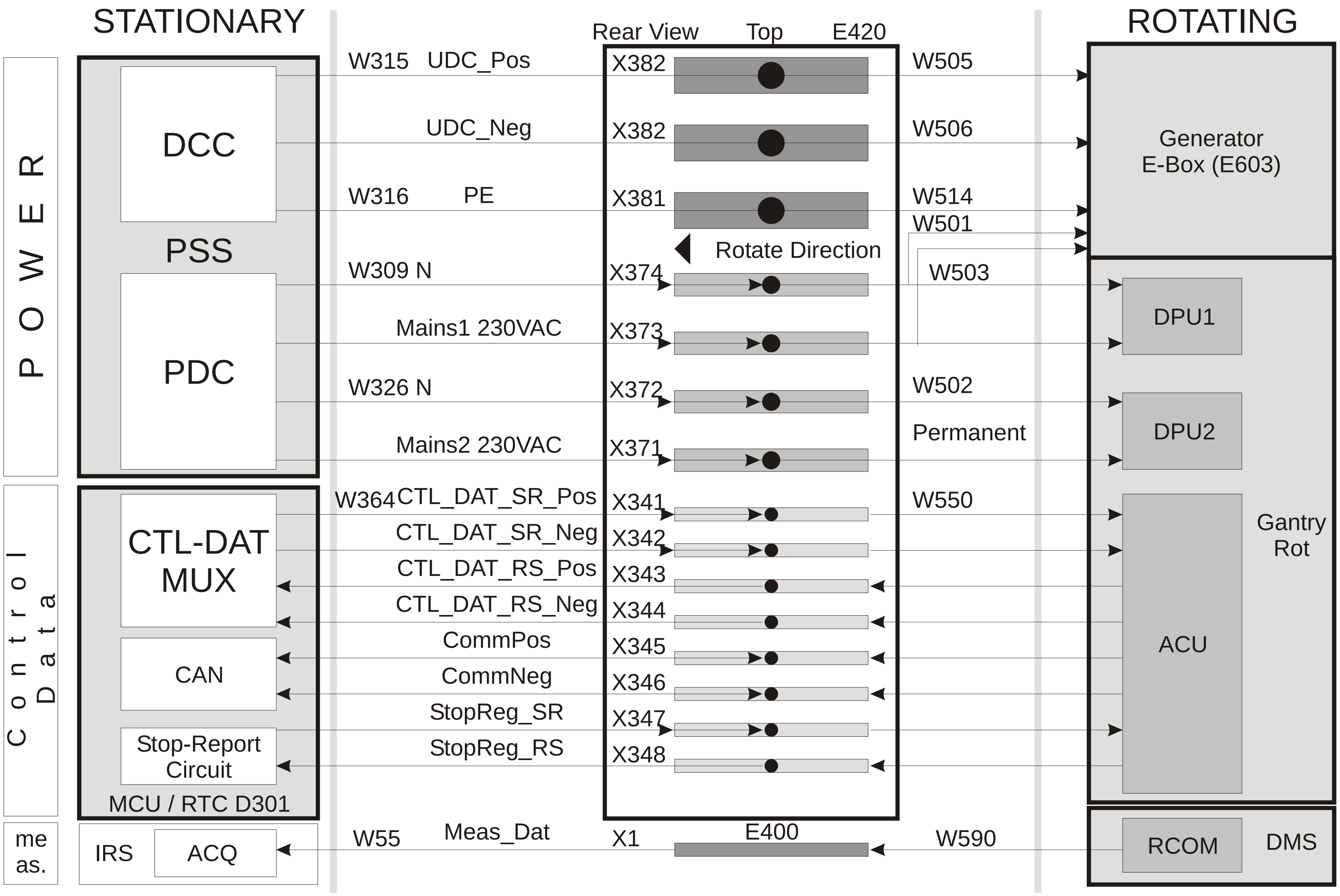

STATIONARY
ROTATING
P O W E R
C o n t r o l
D a t a
me as.
DCC
PSS
PDC
CTL-DAT MUX
CAN
Stop-Report Circuit
MCU / RTC D301
IRS
ACQ
Rear View
Top
E420
W315 UDC_Pos
UDC_Neg
W316 PE
W309 N
Mains1 230VAC
W326 N
Mains2 230VAC
W364 CTL_DAT_SR_Pos
CTL_DAT_SR_Neg
CTL_DAT_RS_Pos
CTL_DAT_RS_Neg
CommPos
CommNeg
StopReg_SR
StopReg_RS
W55 Meas_Dat
X382
X382
X381
Rotate Direction
X374
X373
X372
X371
X341
X342
X343
X344
X345
X346
X347
X348
X1
E400
W505
W506
W514
W501
W503
W502
Permanent
W550
W590
Generator E-Box (E603)
DPU1
DPU2
ACU
Gantry Rot
RCOM
DMS

Figure 3-3: Slip Ring Assembly Block Diagram

Functional Description

The control data slip rings transfer eight control signals to the rotating Gantry and receive eight control signals from the Gantry. The stationary and rotating sides of the Gantry have identical circuits, consisting of the following components:

- Multiplexer sends eight bits via the serial data path
- Demultiplexer receives eight bits via the serial data path
- Controller monitors the transmission

Serial Data Signals

The serial data signals listed in *Table 3-4* are transmitted via differential lines.

Table 3-4: Differential Signals for Serial Data Transmission

BIT	STATIONARY TO ROTATING	ROTATING TO STATIONARY
0	Com_OK	Not Used
1	Speed_OK	Not Used
2	XC_Gen	XC_Ena
3	Not Used	Index
4	HTP	AP0
5	Not Used	AP90
6	Not Used	X-ray
7	Ser_Rx	Ser_Tx

Ser_Tx can be used to connect the nine-pin Canon monitor output from any MCB in the rotating section to the monitor input of the ACU. The ACU connects this input as **Ser_Tx** to channel 7 of the control data multiplexer and transmits it to the MCU where it is demultiplexed. This enables tracing of the monitor line from a rotating MCB at the stationary D301.

The logic circuit on each side monitors the serial data path.

Error Signals

In the controller, the following error signals may be set:

- **REC_ERROR** (Receiver error) **-** Indicates a parity error. One or more of the eight received bits is not correct.
- **SYNC_ERR** (Synchronization error) **-** The path is an asynchronous serial data path. If synchronization is lost by the demultiplexer, this error signal is set.
- **K.MCU** (Communication OK with MCU) **-** This LED lights when there is no synchronization error detected on the receiver side of the ACU.

Figure 3-4 shows how the control data part of the slip ring assembly works.

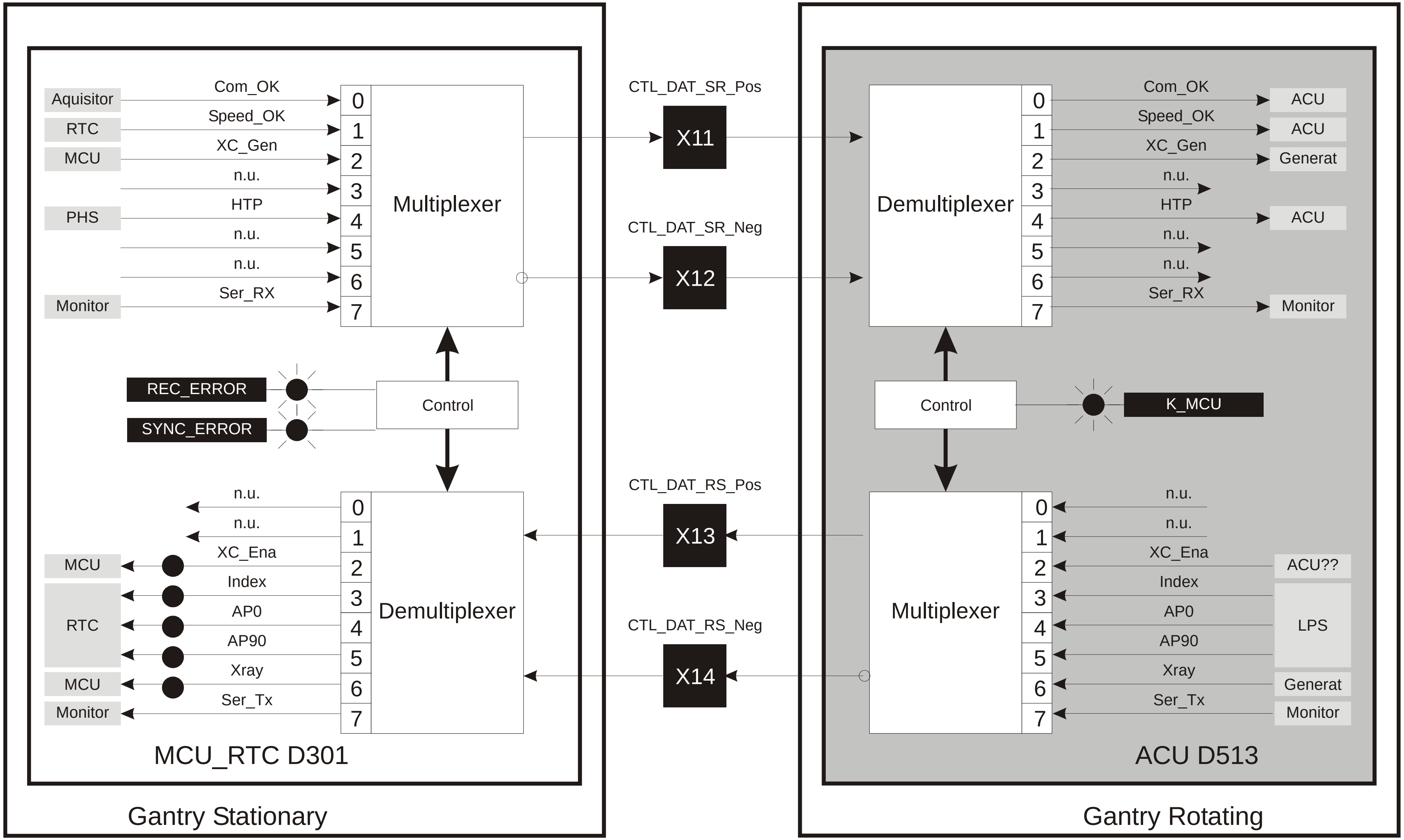

Aquisitor
RTC
MCU
PHS
Monitor
Com_OK
Speed_OK
XC_Gen
n.u.
HTP
n.u.
n.u.
Ser_RX
0
1
2
3
4
5
6
7
Multiplexer
REC_ERROR
SYNC_ERROR
Control
n.u.
n.u.
XC_Ena
Index
AP0
AP90
Xray
Ser_Tx
MCU
RTC
MCU
Monitor
Demultiplexer
MCU_RTC D301
Gantry Stationary
CTL_DAT_SR_Pos
X11
CTL_DAT_SR_Neg
X12
CTL_DAT_RS_Pos
X13
CTL_DAT_RS_Neg
X14
Demultiplexer
ACU
ACU
Generat
ACU
Monitor
Control
K_MCU
Multiplexer
ACU??
LPS
Generat
Monitor
ACU D513
Gantry Rotating

Figure 3-4: Control Data Block Diagram

CAN and Stop-Report Signals

The CAN signals, **CommPos** and **CommNeg**, are connected directly to the MCB of the D513 ACU board.

The status of the Stop-Report loop of the stationary and rotating parts of the Gantry is transferred via the slip rings, as shown in *Figure 3-5*.

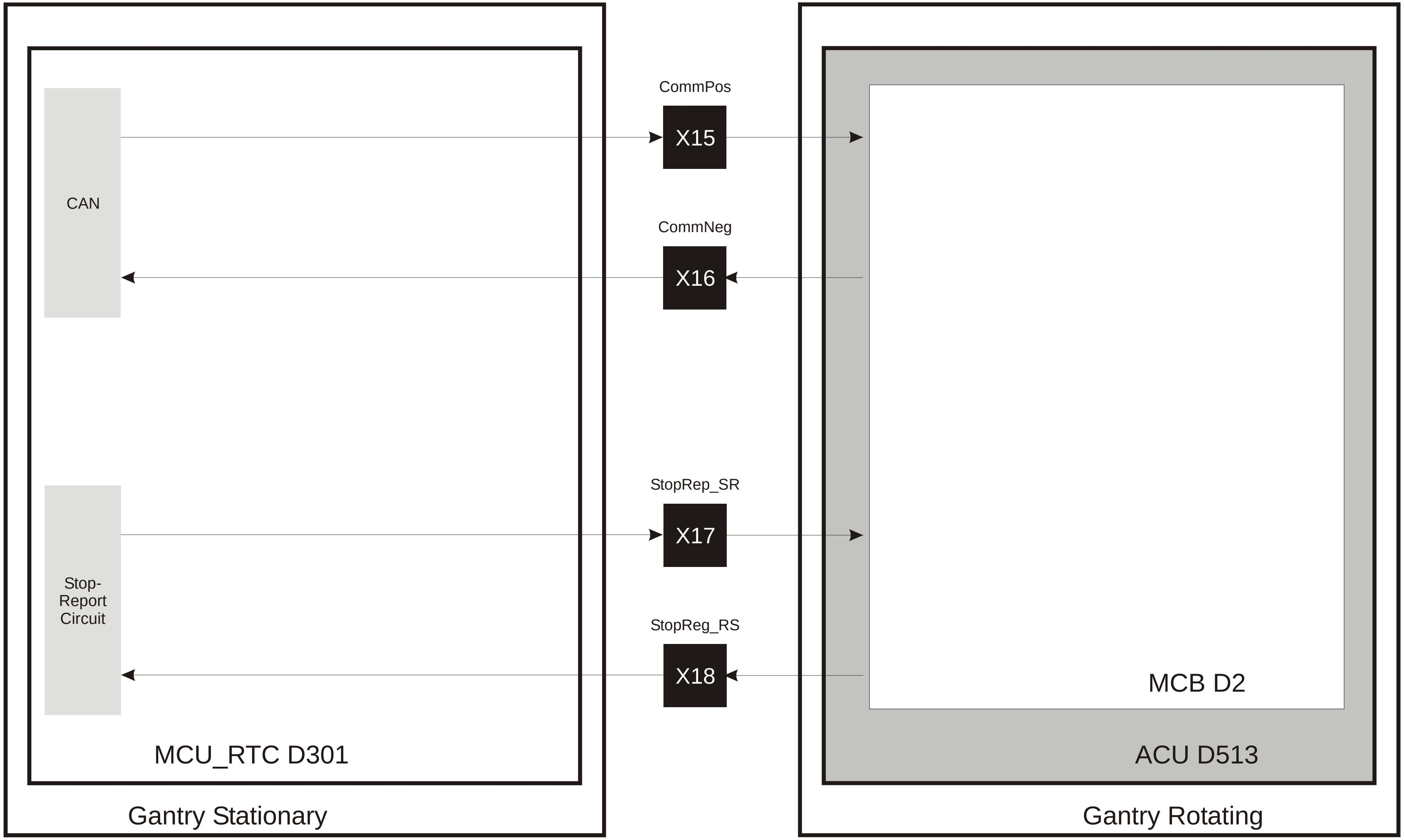

CommPos
X15
CAN
CommNeg
X16
StopRep_SR
X17
Stop-
Report
Circuit
StopReg_RS
X18
MCB D2
MCU_RTC D301
ACU D513
Gantry Stationary
Gantry Rotating

Figure 3-5: System Control Slip Ring System CAN/STOP-Report

Gantry Stationary Overview

Components

The block diagram in *Figure 3-6* shows a front view of the Gantry Stationary with its major components.

Table 3-5:

COMPONENT	DESCRIPTION
Left Stand	The MCU/RTC is installed on the left stand, on the bottom front side. The Power Supply Stationary (PSS) is located on the rear of the MCU/RTC. There is the Tilt Converter and scan counter at center height. The Rotate Converter is mounted at top of the of the Gantry.
Right Stand	The Tilt Motor is installed on the lower section. The Gantry Panel Control (GPC) is located in the center part of the Gantry, and at the top is the dehumidifier.
Center of Gantry	The Left and Right Gantry Panels are fitted on the front cover of the Gantry, and the Display Panel is in the center. Three heat exchangers, used as boxes for Gantry cooling, are installed in the positions shown in *Figure 3-6*. The Rotate Motor has coils on the stationary part of the Gantry, and magnets in the rotating part of the Gantry.

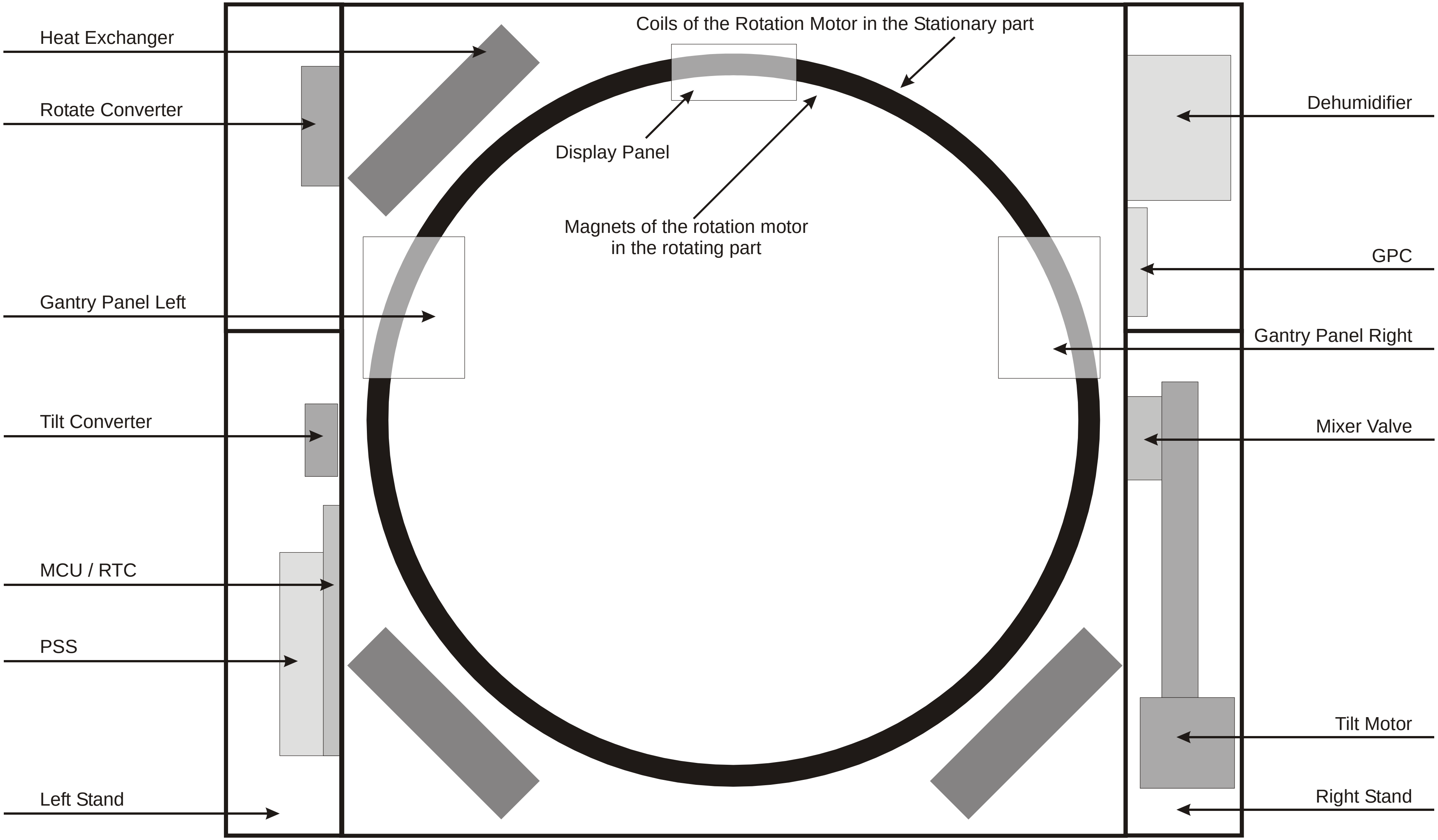

Heat Exchanger
Coils of the Rotation Motor in the Stationary part
Rotate Converter
Dehumidifier
Display Panel
Magnets of the rotation motor in the rotating part
GPC
Gantry Panel Left
Gantry Panel Right
Tilt Converter
Mixer Valve
MCU / RTC
PSS
Tilt Motor
Left Stand
Right Stand

Figure 3-6: Gantry Stationary—General Overview

Gantry Stationary Functional Description

Gantry Stationary Functions

The block diagram in *Figure 3-7* shows all the functions that can be performed in the Gantry Stationary.

Table 3-6: Gantry Stationary Functions

FUNCTION	DESCRIPTION	FUNCTION	DESCRIPTION
Rotation	The acceleration, continuous speed and braking of the rotate motor is controlled by the rotate function.	Patient Handling System PHS Interface	The Patient Handling System Interface shows the interconnection of the PHS to the MCU, necessary to execute all required tasks.
Tilt	The Tilt Control operates the Gantry tilt with a frequency controlled AC-motor.	Optional Hardware	There are System Hardware options.
X-Ray Control	The X-ray Control circuit shows all major control signals required to start the high voltage and to display the state of X-ray on.	Power Supply Stationary (PSS)	The PSS supplies power to all components located in the Gantry stationary, the Gantry rotating, the patient table and the generator.
Audio	The audio allows communication (through a microphone and loudspeaker) between patient and operator.	Patient Handling Control (PHC)	The PHC shows the connection of the GPC to the following: • Gantry panels • Gantry audio logic • Stationary light marker • MCU for control • Power supply station PSS
Gantry Cooling	The Gantry cooling, with heat exchangers and a dehumidifier, keeps the internal Gantry temperature at 26^{o}C (78.8^{o}F ±) ±4^{o}C (±7.2^{o}F), and the relative air humidity between 20%-30%. The nominal temperature-tolerance and humidity values are adjustable by the table T0C.		

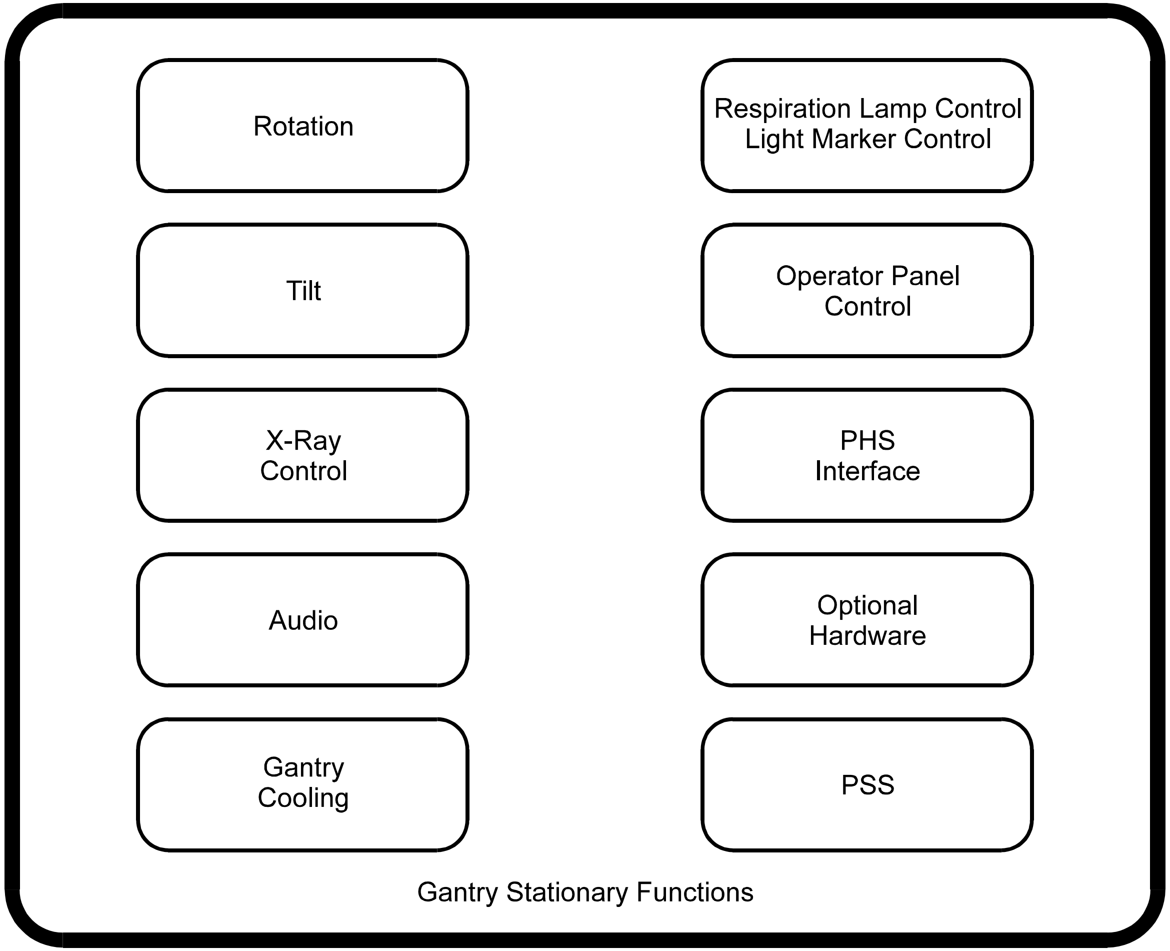

Rotation
Respiration Lamp Control
Light Marker Control
Tilt
Operator Panel Control
X-Ray Control
PHS Interface
Audio
Optional Hardware
Gantry Cooling
PSS
Gantry Stationary Functions

Figure 3-7: Gantry Stationary Functions

Rotation Overview

Tube rotation and positioning is controlled from the RTC-MCB (see *Figure 3-8*).

The rotation circuit includes the D301 MCU/RTC, the E301 rotate frequency converter, the E322 rotate brake assembly, the M301 rotate motor, the stationary slot ring, the D522 rotating LPS board, the Power Supply Station (PSS) and the D513 ACU to transmit the pulses from the slot ring.

Rotating

The rotation speed is controlled with the frequency of the three-phase AC voltage, generated from the frequency converter.

Whenever a mode is loaded, the RTC-MCB receives the nominal speed for the next cycle with the mode table. The MCB instructs the frequency converter, via a serial connection, about the frequency to be generated.

During rotation, and during standstill, the actual speed is monitored from the RTC-MCB. Deviations of the actual speed exceeding the tolerance, or forbidden rotation in standstill, result in a fatal error.

To measure the actual speed, the D522 rotating light barrier detects the angular pulses from the stationary slot ring (1160 slots/revolution) and transmits them through the ACU D513 and the sliprings to the MCU. The LPS controller calculates the actual speed and informs the RTC-MCB.

Positioning

Whenever the tube has to be placed in a fixed position without rotation (for Surview, etc.), the RTC-MCB sends smoothly decreasing frequency values to the frequency converter and the tube is decelerated until it is parked in the desired position.

Whenever such a mode is loaded, the RTC-MCB receives the nominal position for the next cycle with the mode table (AP pulse count between 0 and 1160). The pulse count from the slot ring, in standstill position, has to match the nominal position value within a certain tolerance, otherwise a fatal error is issued.

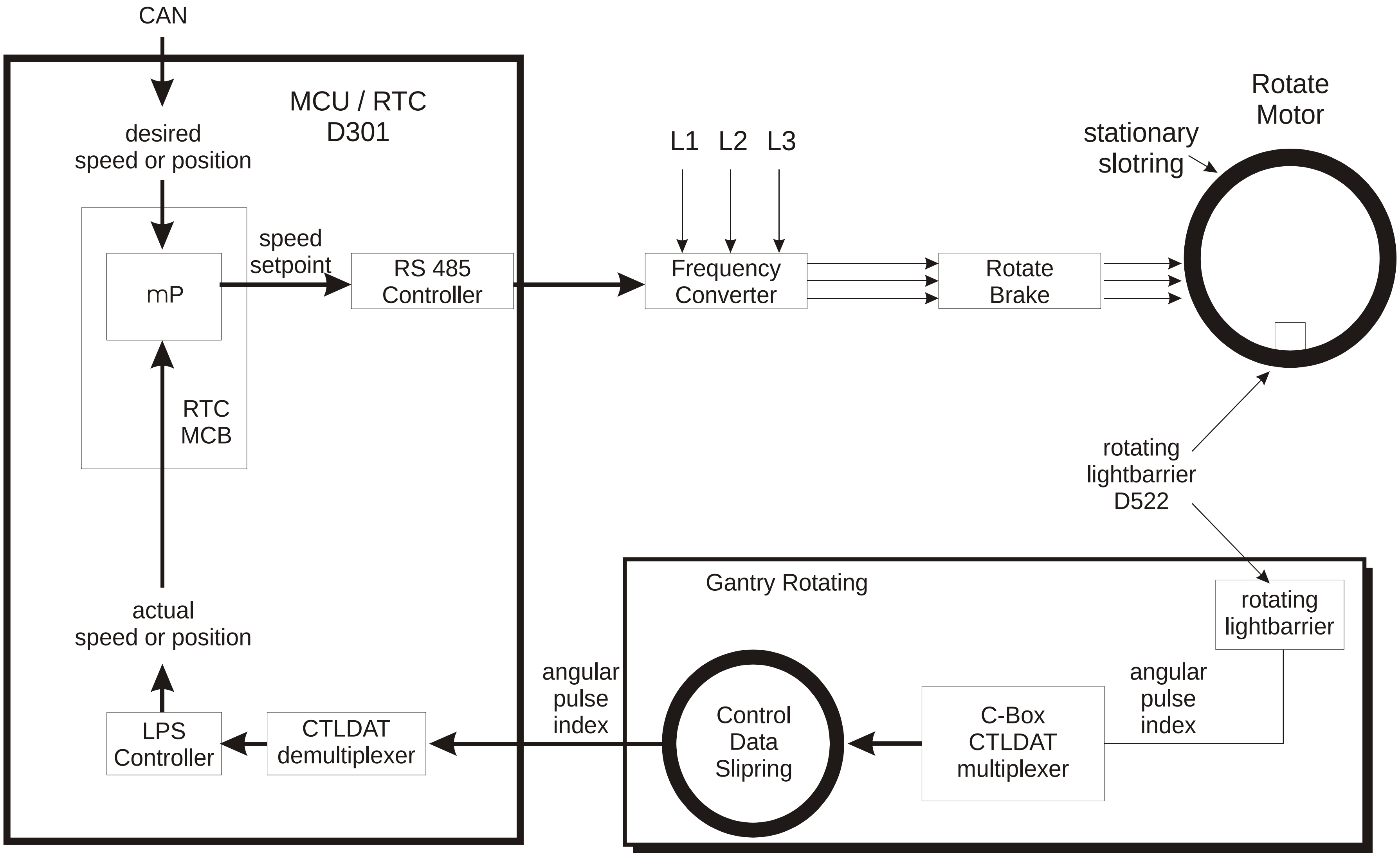

CAN
MCU / RTC
D301
desired
speed or position
mP
speed
setpoint
RS 485
Controller
RTC
MCB
L1
L2
L3
Frequency
Converter
Rotate
Brake
Rotate
Motor
stationary
slotring
rotating
lightbarrier
D522
actual
speed or position
LPS
Controller
CTLDAT
demultiplexer
angular
pulse
index
Gantry Rotating
Control
Data
Slipring
C-Box
CTLDAT
multiplexer
angular
pulse
index
rotating
lightbarrier

Figure 3-8: Gantry Stationary Rotation

Rotation Functions

See *Figure 3-9* for the Gantry Stationary - Rotational function description.

Rotate Motor

The M301 rotate motor is built up as a three-phase linear-motor where the stator has the field coils and the rotor contains the magnets. The motor has no mechanical (parking) brake. The Gantry is held in position by the Frequency Converter (FC) with a constant voltage.

Frequency Converter (FC)

The motor is supplied by a Frequency Converter (FC) with the frequency and voltage for the selected speed. The converter is set up from the RTC function controller by the RS-485 controller with its values (Commrot). In case of error, the FC sends the Errorot message to the MCB.

Stopping Rotation

- Active deceleration controlled from RTC-MCB by driving the motor with smoothly decreasing frequencies till standstill (under regular circumstances).
- Fast braking by disconnecting motor and FC from power and connecting damping resistors to the motor coils (in case of emergency).

LPS Controller

The LPS controller calculates out of the angular pulses (AP0, AP90) and the index pulse (rot_idx) the actual tube position and rotate speed.

CTLDAT

The Control Data Interface is available on the D301 MCU, and on the D513 ACU. It is the multiplexed control data link between the rotating and the stationary Gantry. There are eight channels available on the multiplexer to transmit control signals (including AP0, AP90 and Rot_idx) from the rotating to the stationary section with the Ctl_Dat_RS signal line.

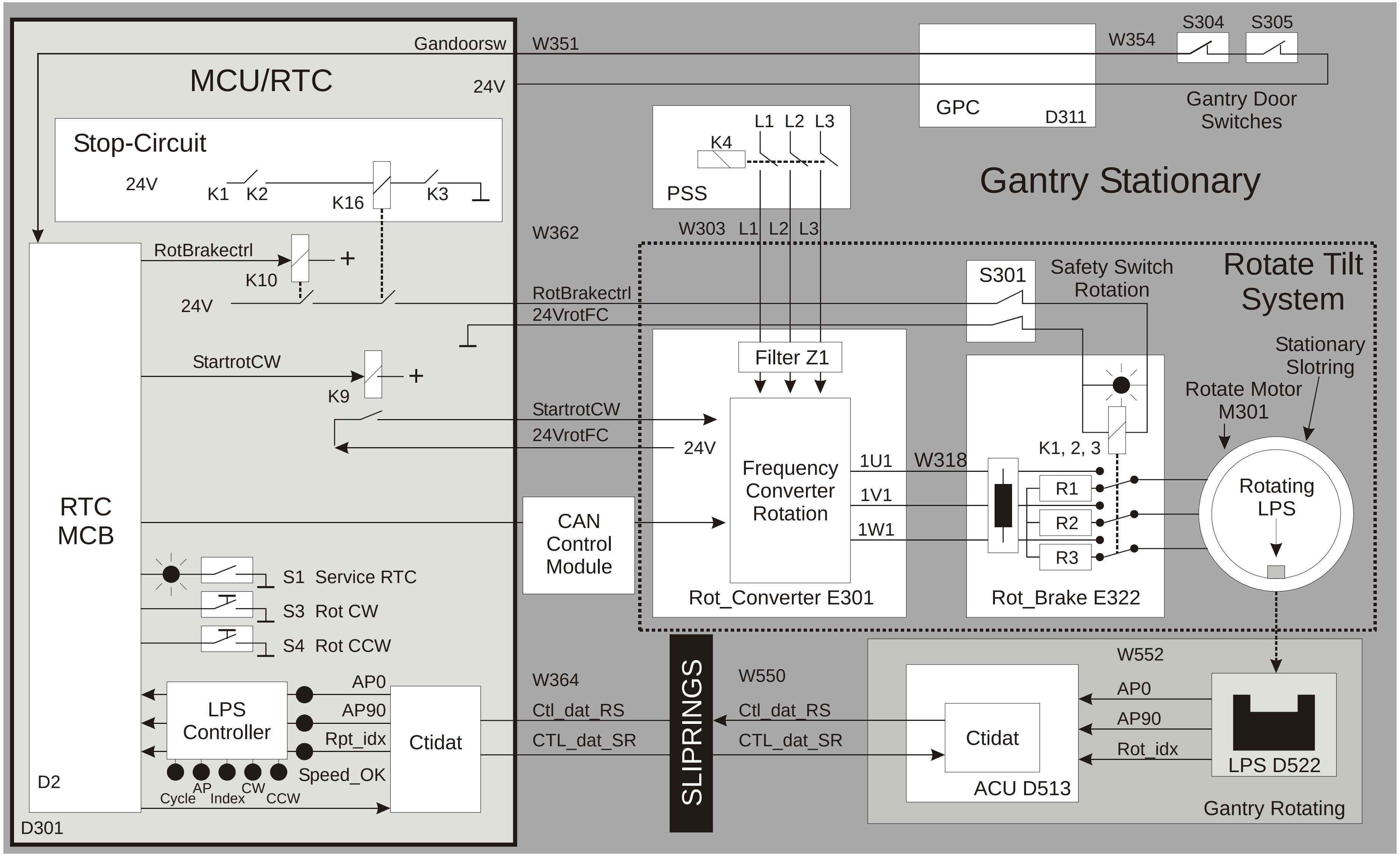

MCU/RTC
Gandoorsw
W351
24V
Stop-Circuit
24V
K1
K2
K16
K3
W362
RotBrakectrl
K10
24V
RotBrakectrl
24VrotFC
StartrotCW
K9
StartrotCW
24VrotFC
RTC
MCB
S1 Service RTC
S3 Rot CW
S4 Rot CCW
LPS
Controller
AP0
AP90
Rpt_idx
Speed_OK
Cycle
AP
Index
CW
CCW
Ctidat
D2
D301
W364
Ctl_dat_RS
CTL_dat_SR
CAN
Control
Module
SLIPRINGS
W550
Ctl_dat_RS
CTL_dat_SR
GPC
D311
W354
S304
S305
Gantry Door
Switches
PSS
K4
L1 L2 L3
W303 L1 L2 L3
Gantry Stationary
Rotate Tilt
System
S301
Safety Switch
Rotation
Filter Z1
24V
Frequency
Converter
Rotation
1U1
1V1
1W1
W318
Rot_Converter E301
K1, 2, 3
R1
R2
R3
Rot_Brake E322
Stationary
Slotring
Rotate Motor
M301
Rotating
LPS
W552
AP0
AP90
Rot_idx
Ctidat
ACU D513
LPS D522
Gantry Rotating

Figure 3-9: Gantry Stationary - Rotation Functional Description

Enable Rotation

There are two signals needed to enable rotation (see *Figure 3-10*):

- StartRotCW:
  Enables the converter with K9 (24 V from E301 are looped back)
- RotBrake
  Ctrl:Activates K10 on D301, K1-K3 in E322 and connects power to the motor by looping back 24 V from E301

Disable (STOP) Rotation

This signal is issued if either the Stop Report Loop is interrupted (e.g. STOP button pressed) or if the MCB detects any severe rotation fault (such as speed out of tolerance).

In either case the MCB generates the STOP signal. This signal immediately disables the frequency converter. As a result, the converter is disconnected from power. To avoid “Generator Operation” (which would overload the converter), the relays K1-K3 are disabled and the damping resistors of E322 are connected to the motor via RotBrakeCtrl. The motor energy is neutralized and the Gantry is brought to the fastest possible stop.

Power supply 24VRotFC

24 V from E301, connected back to the frequency converter, if K9 is closed.

24V_GND

Ground for 24 V

Faults ErrorRot

Error from the frequency converter, e.g., if communication is disturbed, the current is too high.

Safety S301

This is the rotation safety switch which must be closed to allow rotation. If S301 is opened, no rotation is possible.

CommRot

RS-485 communication between MCU and the frequency converter (FC). The FC receives its parameters through this line.

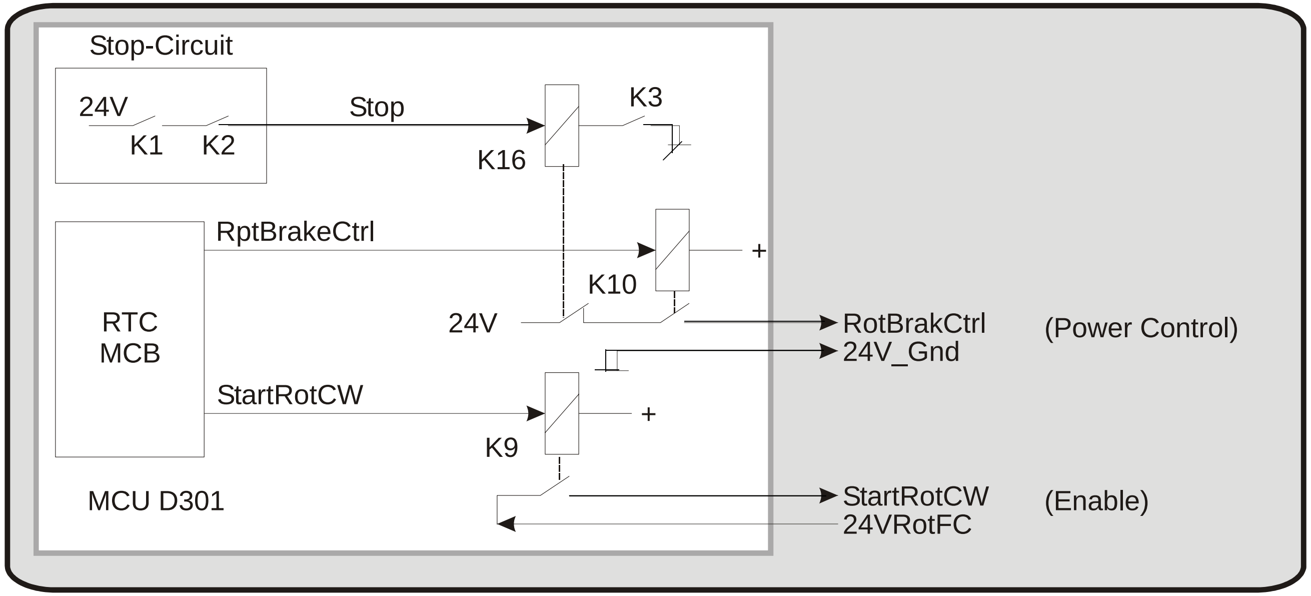

Stop-Circuit
24V
K1
K2
Stop
K16
K3
RptBrakeCtrl
RTC
MCB
K10
+
24V
RotBrakCtrl
24V_Gnd
(Power Control)
StartRotCW
+
K9
MCU D301
StartRotCW
24VRotFC
(Enable)

Figure 3-10: Rotation Enable and Direction Circuit

To enable rotation the RTC_MCB has to set RotBrakeCtrl which activates K10 and connects 24V through E301, the rotation Safety switch S301 and the contactors K1-K3 in E322 back to ground (24V_GND). As a result K1-K3 are activated and connect the frequency output of the converter, instead of the damping resistors, to the motor.

Additionally StartRotCW has to be set from the RTC controller, activating K9 and looping 24V (24VRotFC) back to the frequency converter. This serves as enable for the converter.

If a STOP state occurs, the Stop signal activates K16 and clears RotBrakeCtrl. The motor is connected to the damping resistors and this rotation stops.

GandoorSw

The Gantry Door Switch current loop reports the opening of the Gantry door to the Rotate Tilt Control MCB (RTC-MCB) via GPC D311 and MCU. The RTC-MCB informs the Host, via a status table, about any changes in the switch condition. Opening of the door, when a rotation mode has been loaded, causes a fatal error and the RTC actively decelerates and stops rotation. After a reset, however, rotation can be resumed, even if the front door is open.

Table 3-7: Pulses from D522

AP0	These are Angular Pulses, detected from one light barrier on the rotating D522 LPS board. There are 1160 AP0 pulses generated per revolution.
AP90	These are Angular Pulses which are 90× phase-shifted in respect to the AP0 pulses, generated on the rotating D522 LPS board. These pulses are necessary to detect the direction of rotation. There are 1160 AP90 pulses generated per revolution.
Rot_idx	Rot_idx is the index pulse, detected from a second light barrier on the rotating LPS board D522. This pulse occurs once per revolution.

S1-Service RTC	S1-Service is the RTC service mode ON/OFF (LED on = service mode on)
S3-RotCW	Clockwise rotation in service mode, with service speed, as long as this button is pressed (approximately 20 s/rev)
S4-RotCCW	Counterclockwise rotation, in service mode with service speed, as long as this button is pressed (approximately 20 s/rev)
Rot Brake LEDs	These green LEDs light up if the corresponding contactors K1-K3 are energized.

LPS Controller

Rotation

The Angular Pulses (APs) are counted in a pulse counter. The Index Pulse resets the counter and a new count is started. After a complete revolution, the contents of the counter must be 1160 (number of APs). If that is not the number, an error is generated.

In parallel, the direction of rotation is checked out of AP0 and AP90, time between APs is taken for speed detection and the exact rotation time is measured. These results can be fetched from the RTC_MCB.

Start Angle

Several scan modes with rotation start the scan only in defined positions, such as:

Start-angle -5°-+5° or 175°-185°

Whenever the first possible start-position is reached, the comparator, receiving the nominal start-angle with the TF0 mode table and the actual tube position from the pulse counter, issues RotposOK to the MCU_MCB. The MCU generates Xcen_FW to switch on high voltage in this tube position.

Positioning

To position the tube at a fixed angle, it is moved with slow speed until the actual AP pulscount (actual position) matches the nominal park-position (any number between 0-1160). In this moment, the comparator, receiving nominal and actual position, issues the signal Int_PQ to the RTC_MCB, which stops the tube.

Monitoring

Monitoring of the rotate speed is done from both MCBs on the D301. The RTC_MCB is informed directly from the LPS controller. For double safety, the MCU_MCB also monitors the speed. Since the MCU_MCB is busy with other tasks as well, it is supplied only a slowed-down pulse frequency SlowAP for monitoring.

Whenever a controller detects a speed out of tolerance, the stop report loop is opened and the resulting Stop signal brakes the motor (see Enable/Disable rotation).

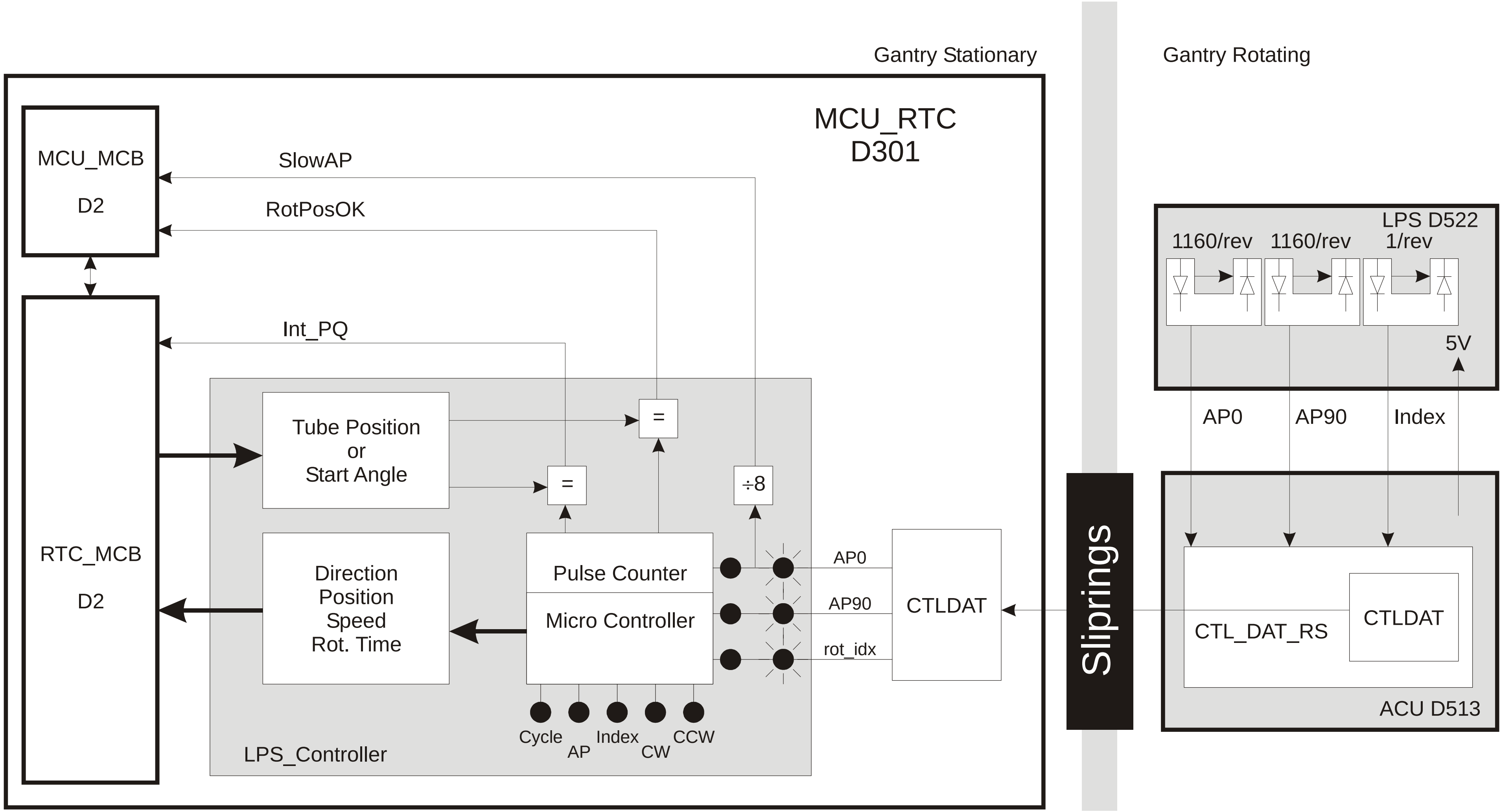

Gantry Stationary
Gantry Rotating
MCU_RTC
D301
MCU_MCB
D2
SlowAP
RotPosOK
Int_PQ
RTC_MCB
D2
Tube Position or Start Angle
=
=
÷8
Direction Position Speed Rot. Time
Pulse Counter
Micro Controller
AP0
AP90
rot_idx
CTLDAT
Cycle
AP
Index
CW
CCW
LPS_Controller
Sliprings
LPS D522
1160/rev
1160/rev
1/rev
5V
AP0
AP90
Index
CTL_DAT_RS
CTLDAT
ACU D513

Figure 3-11: Rotation - LPS Channel

Gantry Tilt Overview

The Gantry Tilt is controlled from the RTC-MCB. A tilt is possible in the range of +30° to -30°. The Positive Tilt Angle corresponds to a forward tilting, with the top towards the Patient Table.

Within the above tilt-range there are two different speeds used:

- Fast speed for tilt angles <25°
- Slow speed for tilt angles >25°

Tilting outwards runs with fast speed in the range of +/-25° and the Gantry stops at +25° and -25°. Tilting outwards beyond this angle continues only with another push of the button, but with slow speed. Tilting the Gantry back inwards always runs with fast speed. The Gantry always stops automatically at 0° in the manual operation.

There are two ways to start a tilt function:

- Manual operation from the panels at the Gantry (customer) or from the service buttons on D301 (service)
- Automatic operation under software control from the protocol

Manual Mode

The RTC_MCB periodically reads out the actual tilt position from the tilt-encoder and thus always knows where the Gantry is.

Whenever a tilt button on the Gantry panel is pressed, the RTC_MCB is informed through the CAN bus from the GPC_MCB. Depending on the actual position (<25° or >25°) the RTC sets up the frequency converter (FC) through the RS-485 line. According to the generated output frequency, the Gantry is either tilted fast or slow, as long as the tilt request (button pressed) is active.

During tilt, the actual position is continuously transmitted through the CAN bus to the GPC_MCB to be displayed at the LCD display in the Gantry panels.

Automatic Mode

The operator defines a tilt angle in the protocol and loads a mode. The RTC_MCB receives the information about the requested nominal tilt position with the corresponding mode table through the CAN bus. To tilt the Gantry after MODE_LOADED, you must press the enable button on the Control Scan Unit. In this case, the RTC sets up the FC through the RS-485 line and the Gantry tilts according to the generated output frequency.

The actual position is continuously fetched from the tilt-encoder, and the movement stopped if actual and nominal position match one another. During tilt, the actual position is continuously transmitted through the CAN bus to the GPC_MCB to be displayed at the LCD display in the Gantry panels.

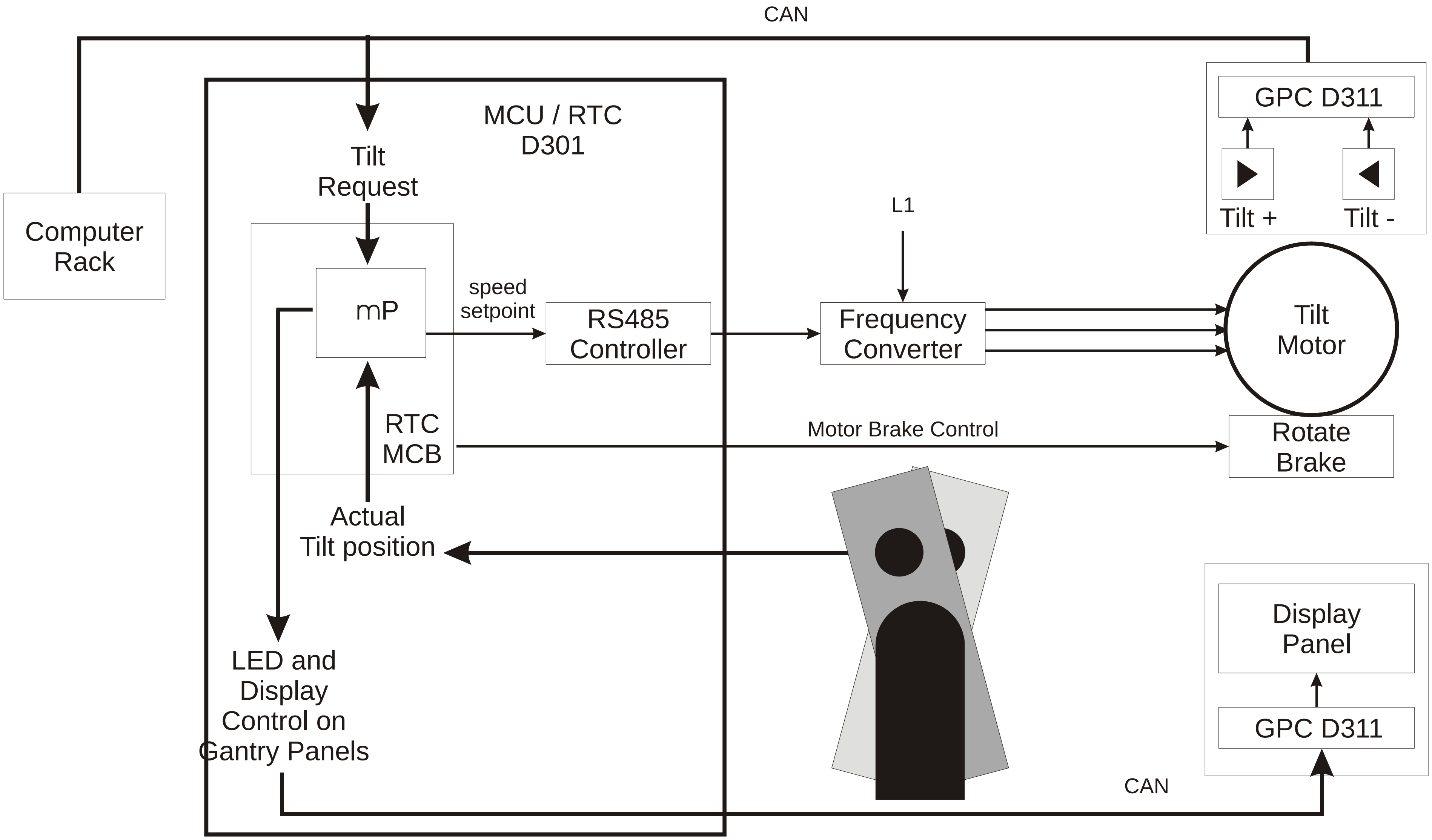

CAN
MCU / RTC
D301
Tilt
Request
Computer
Rack
mP
speed
setpoint
RS485
Controller
L1
Frequency
Converter
GPC D311
Tilt +
Tilt -
Tilt
Motor
RTC
MCB
Motor Brake Control
Rotate
Brake
Actual
Tilt position
LED and
Display
Control on
Gantry Panels
Display
Panel
GPC D311
CAN

Figure 3-12: Gantry Stationary Tilt

Gantry Tilt Functions

Components

The tilt circuit includes the following:

- MCU D301
- E302 Tilt Frequency Converter
- M302 Tilt Motor
    - Y2 Motor Brake
    - B301 Tilt Sensor
    - Power Supply Stationary (PSS)

The M302 is a three-phase asynchronous motor with a built-in mechanical brake to hold the Gantry in a defined inclination. Further, a temperature switch, inside the motor housing indicates overheating.

The motor is driven by a frequency converter (FC) which converts the single-phase 230 VAC input into the required three-phase 230 VAC motor supply. The generated frequency and voltage determines the tilt speed. The single-phase supply for the FC passes the solid state relay D324 in the PSS.

The converter is set up from the RTC function controller by the RS-485 controller with its values (CommTilt). In case of error, the FC sends the ErrorTilt message to the MCB.

For tilting the Gantry, the RTC_MCB has to set up the FC through the RS-485 controller with its values (CommTilt). Additionally, the FC has to be started and the motor brake has to be released. A spindle converts the motor rotation into a linear vertical movement which tilts the Gantry forward or backward.

The actual tilt angle is constantly watched from the RTC_MCB by evaluating the output of the tilt sensor inside the Gantry. If the desired tilt position is reached, the RTC_MCB stops the FC and engages the tilt brake.

In case of emergency, when a stop is activated, the Gantry tilt is immediately stopped by disconnecting the single-phase supply to the FC with Solid State relay D324 and activation of the motor brake.

Table 3-8: Signals Needed For Tilting

SIGNAL	DESCRIPTION
Dir1Tilt	Enables the converter with K11 (15 V from E302 are looped back)
Dir2Tilt	Defines the tilt direction with K12 (15 V from E302 are sometimes looped back)
BrakeTilt	Releases the brake by connecting 24 V to the brake assembly

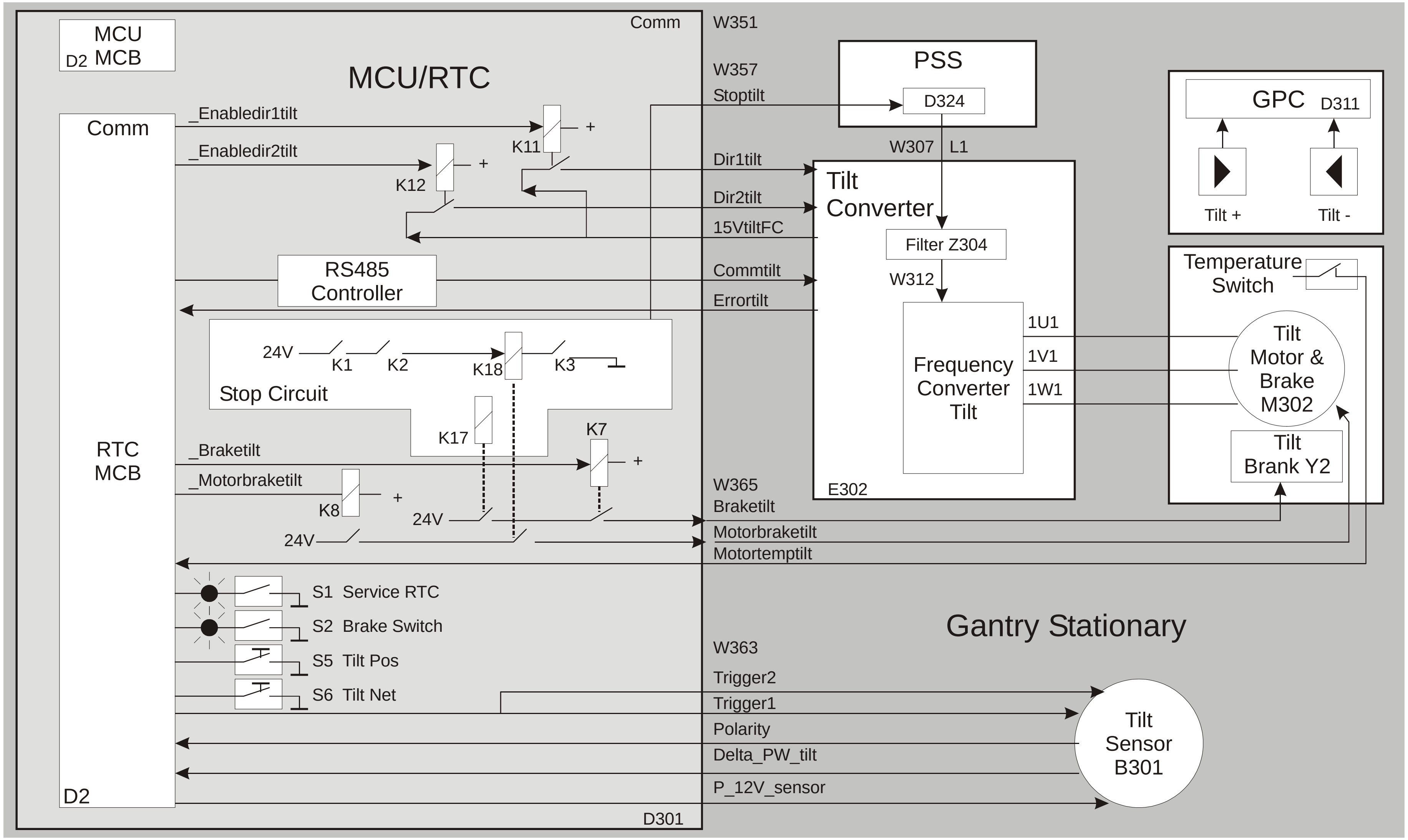

MCU
D2 MCB
Comm
MCU/RTC
Comm
_Enabledir1tilt
_Enabledir2tilt
K11
K12
RS485
Controller
24V
K1
K2
K18
K3
Stop Circuit
K17
K7
RTC
MCB
_Braketilt
_Motorbraketilt
K8
24V
24V
S1 Service RTC
S2 Brake Switch
S5 Tilt Pos
S6 Tilt Net
D2
D301
W351
W357
Stoptilt
Dir1tilt
Dir2tilt
15VtiltFC
Commtilt
Errortilt
W365
Braketilt
Motorbraketilt
Motortemptilt
W363
Trigger2
Trigger1
Polarity
Delta_PW_tilt
P_12V_sensor
PSS
D324
W307
L1
Tilt
Converter
Filter Z304
W312
Frequency
Converter
Tilt
1U1
1V1
1W1
E302
GPC
D311
Tilt +
Tilt -
Temperature
Switch
Tilt
Motor &
Brake
M302
Tilt
Brank Y2
Gantry Stationary
Tilt
Sensor
B301

Figure 3-13: Tilt Control

Stop

This signal is issued from the MCB if either the Stop Report Loop is interrupted (e.g. stop button is pressed) or the MCB detects any severe tilt fault.

In either case, the MCB generates the signal Stop. This immediately disconnects the frequency converter from power with D324 and activates the brake by disconnecting the 24 V to the brake assembly (BrakeTilt).

Power Supply

Table 3-9:

SIGNAL	DESCRIPTION
24V	24 V power supply from MCU, among others, used to release the brake
15VTiltFC	15 V from E302 connected back to the FC for enable and direction select
15V_GND	Ground for 15 V

Faults

Table 3-10:

SIGNAL	DESCRIPTION
ErrorTilt	Error from FC tilt, e.g. if communication disturbed, current too high, etc.
CommTilt	RS-485 communication between MCU and FC. The FC receives its parameter through this line.

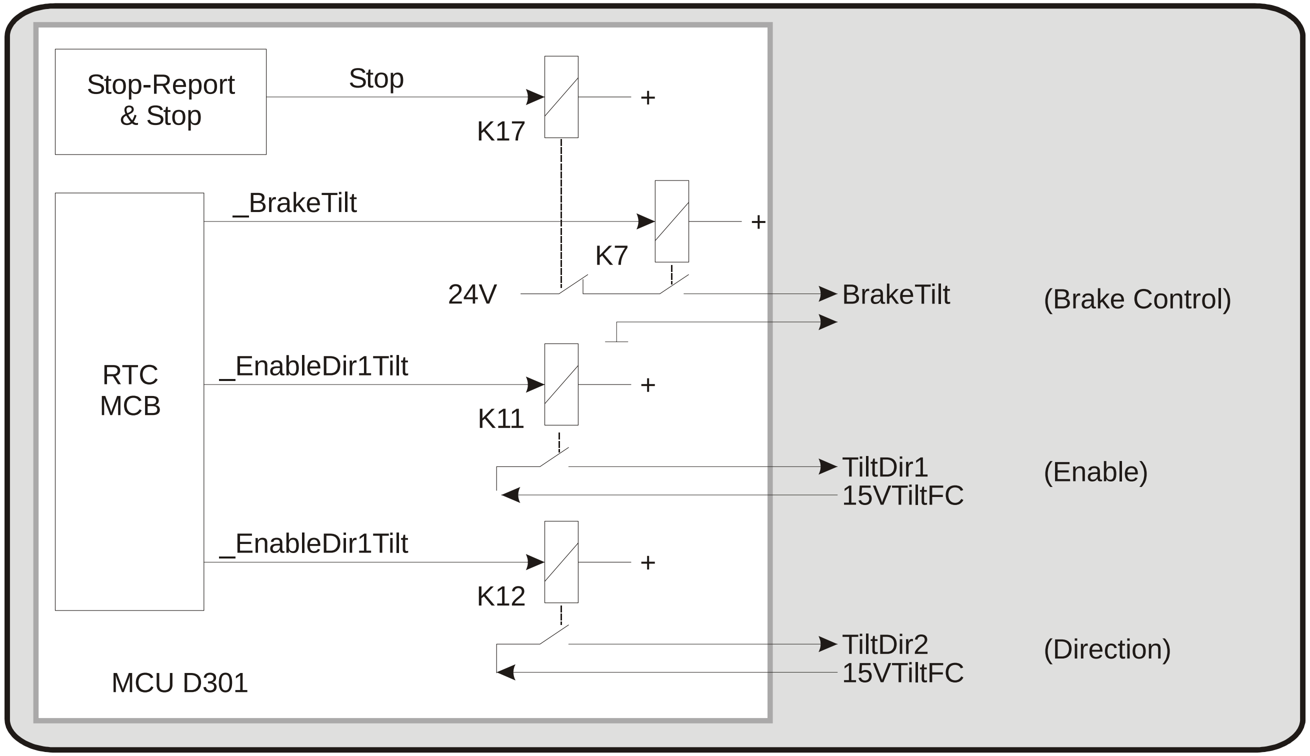

Stop-Report
& Stop
Stop
K17
+
_BrakeTilt
+
K7
24V
BrakeTilt
(Brake Control)
RTC
MCB
_EnableDir1Tilt
+
K11
TiltDir1
15VTiltFC
(Enable)
_EnableDir1Tilt
+
K12
TiltDir2
15VTiltFC
(Direction)
MCU D301

Figure 3-14: Tilt Enable and Direction Circuit

To start tilting the RTC_MCB has to set _EnableDir1Tilt which activates K11 and connects 15V through D301 back to the frequency convertor. This serves as enable for the FC.

Additionally the tilt direction has to be set from the RTC controller with _EnableDir2Tilt (high or low), i.e. K12 either activated or not. Further the RTC_MCB has to release the brake with _BrakeTilt, connecting 24V to the brake assembly.

If a STOP state occurs, the Stop signal deactivates the single-phase supply to the FC and second activated K17 which clears BrakeTilt. The tilt motor stops immediately.

MotorTempTilt

This is the temperature safety switch which must be closed to allow any tilt motor activity. The switch opens at 100º C (212º F). If the RTC_MCB receives a low active MotorTempTilt signal, it immediately clears the enable (Dir1Tilt) for the motor and issues a fatal error.

Pulses from/to the Tilt Encoder

Table 3-11:

SIGNAL	DESCRIPTION
Trigger1 Trigger2	The RTC_MCB initiates a measurement with a trigger pulse and the sensor returns the pulse Delta_PW_Tilt
Polarity	The signal level informs the RTC_MCB about the tilt direction, either positive or negative
Delta_PW_Tilt	The pulse width of this signal is proportional to the tilt angle. The RTC_MCB evaluates the pulse width to find out about the actual tilt position.
P_12V_Sensor	12 V power supply of the tilt sensor from D301

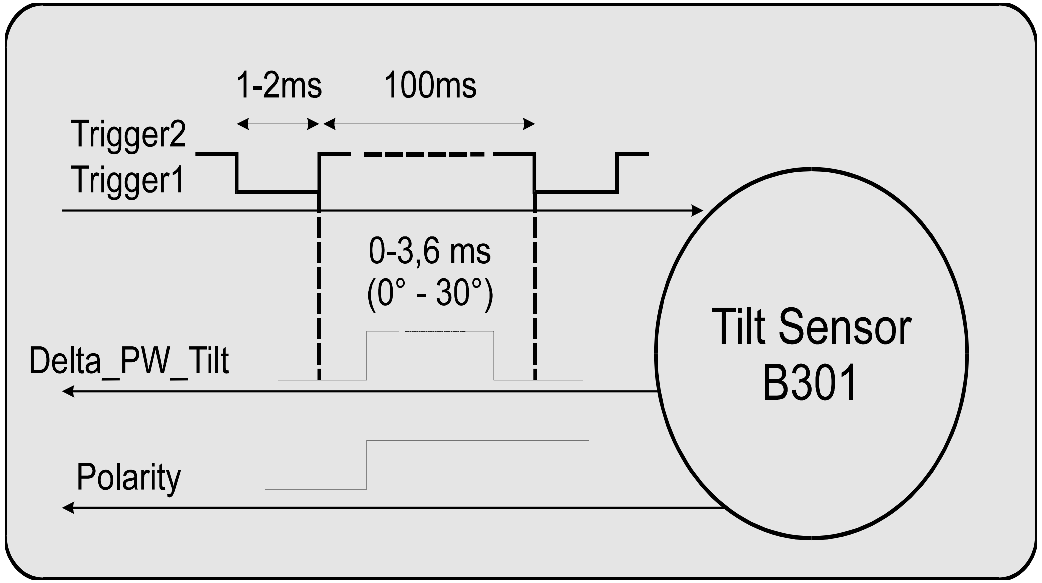

1-2ms
100ms
Trigger2
Trigger1
0-3,6 ms
(0° - 30°)
Delta_PW_Tilt
Polarity
Tilt Sensor
B301

Figure 3-15: Tilt Encoder Signals

Service

The service switches in *Table 3-12* are on the MCU/RTC board.

Table 3-12:

SIGNAL	DESCRIPTION
s1-service rtc	RTC service mode on/off (LED on = service mode on)
s5-tilt pos	Positive tilt (Gantry top towards table) as long as this push button is pressed
s6 tilt neg	Negative tilt as long as this push button is pressed
s2 brake switch	Activating this button releases the tilt brake

Gantry Cooling

The Mx8000 Gantry has a system integrated cooling circuit and dehumidifier.

The circuit has a constant cold water supply, and a mixer valve, controlled by the MCU/RTC control board, which regulates the Gantry temperature to 26^{o}C (78.8^{o}F ±) $\pm 4^{o}$C ($\pm 7.2^{o}$F). The mixer valve supplies the necessary amount of water for temperature control, to three water-air heat exchangers, located in the Gantry.

The mixer valve is driven by the MixValve Drive on the MCU/RTC control board.

The B304 sensor picks up the actual Gantry temperature that is used for regulation.

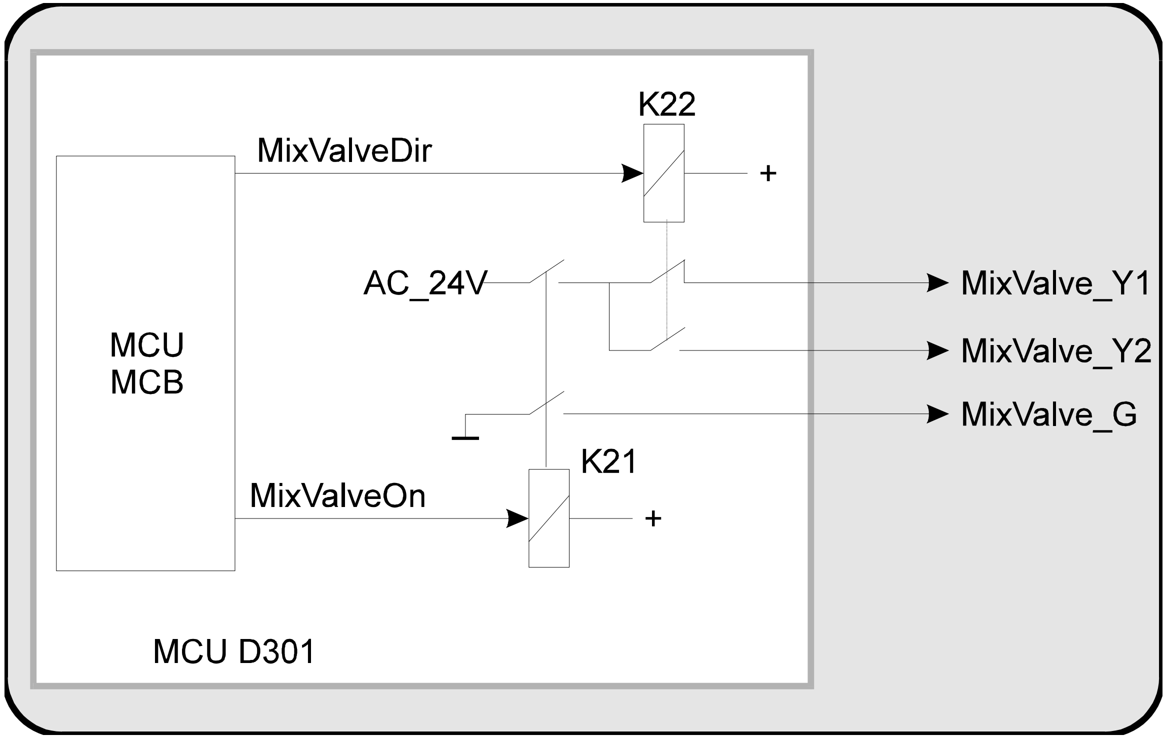


Figure 3-16: Gantry Cooling Mix Valve Drive

Patient Handling Control (PHC)

The Patient Handling Control (PHC) is used to bring the patient into the correct position for scanning a specific area of the body.

Patient Table motion is initiated from the Gantry Stationary either by the software or by the Gantry panels on the front of the Gantry.

The signals for controlling the PHC are sent from the GPC control board to the MCU, and power is supplied from the PSS of the Gantry Stationary.

The PSS supplies +12 V and +24 V to the GPC, where a DC/DC converter generates the Vcc voltage of +5 V from the +12 V.

All three DC-voltages are monitored with LEDs on the GPC control board.

Three stationary light markers show the scanning area.

A lamp lights-up on the rear funnel to signal the patient when to hold his/her breath.

The communication between the GPC, the Gantry Panels and the Scan Control Unit is a serial communication.

The communication between the GPC and the Display is also a serial communication.

The left Gantry Panel is the last link in a continuing connection from the right panel.

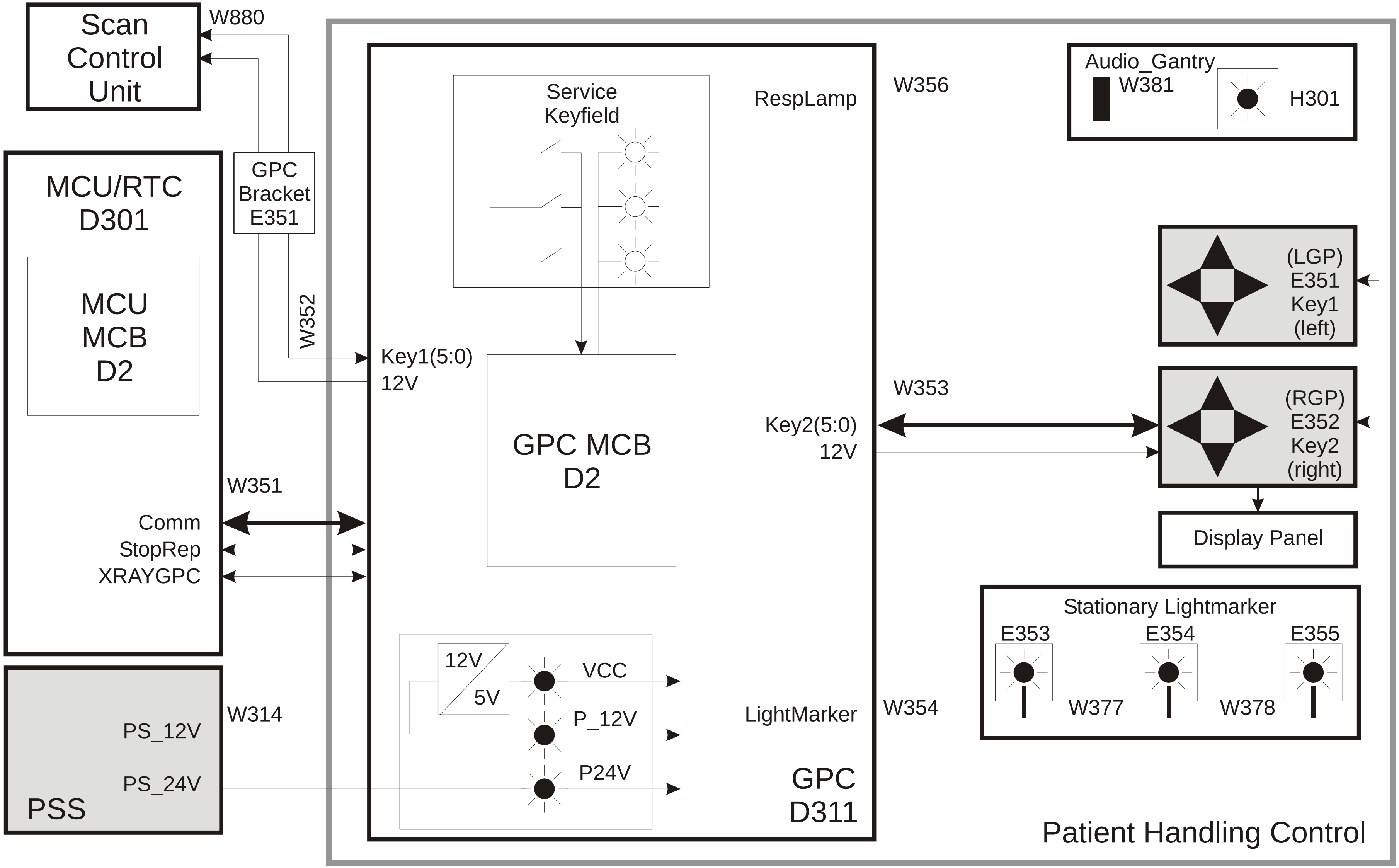

Scan Control Unit
W880
MCU/RTC D301
MCU MCB D2
GPC Bracket E351
W352
W351
Comm
StopRep
XRAYGPC
PSS
PS_12V
PS_24V
W314
Service Keyfield
Key1(5:0)
12V
GPC MCB D2
12V
5V
VCC
P_12V
P24V
RespLamp
Key2(5:0)
12V
LightMarker
GPC D311
W356
Audio_Gantry
W381
H301
(LGP) E351 Key1 (left)
W353
(RGP) E352 Key2 (right)
Display Panel
Stationary Lightmarker
E353
E354
E355
W354
W377
W378
Patient Handling Control

Figure 3-17: Patient Handling Control

Audio-Intercom

The Intercom consists of the following components:

Mic-Gan

Two Gantry microphones and a loudspeaker (located at the rear funnel of the Gantry) are connected to the D342 Microphone-Preamplifier Gantry board. The D342 contains the microphone preamplifiers. The analog audio signals, which the D342 generates, are transmitted to the Noise Cancellation (Noise-Can) board.

Noise-Cancellation

The D344 Noise Cancellation board performs noise cancellation of the microphone signal lines. It is serially connected to the serial interface in the IRS for host control.

Scan Control Unit

Communication with the patient is through the Scan Control Unit, which contains push-buttons for talk-and listen control. The loudspeaker and microphone lines pass through MCU/RTC to the D344 Noise Cancellation board.

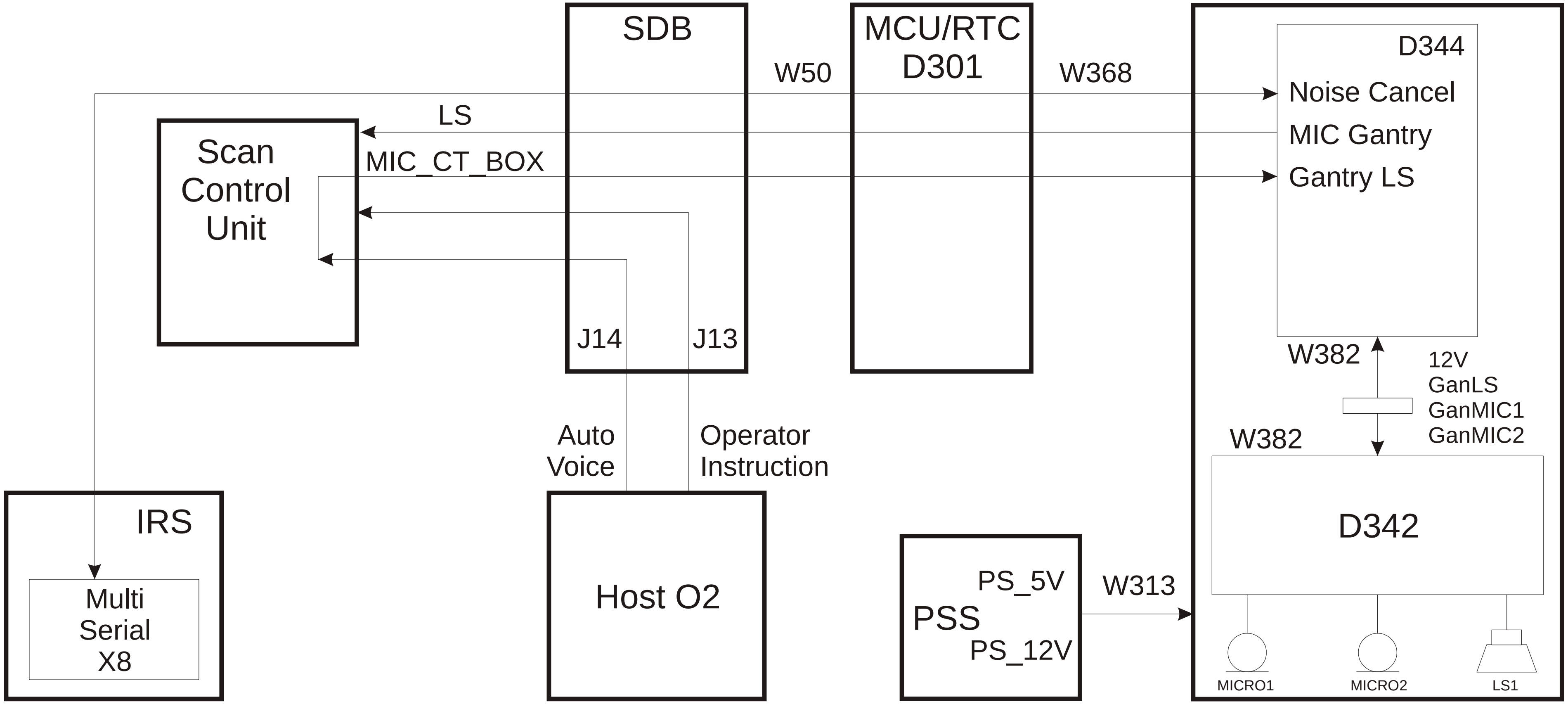

SDB
MCU/RTC
D301
W50
W368
D344
Noise Cancel
MIC Gantry
Gantry LS
LS
Scan
Control
Unit
MIC_CT_BOX
J14
J13
W382
12V
GanLS
GanMIC1
GanMIC2
W382
Auto
Voice
Operator
Instruction
IRS
Multi
Serial
X8
Host O2
PS_5V
PSS
PS_12V
W313
D342
MICRO1
MICRO2
LS1

Figure 3-18: Audio - Intercom

X-Ray Control

The X-ray control circuit sends the required signal to the generator for starting high voltage. The following occurs:

1. Read-back from the generator: that X rays are switched on
2. Signals for the X-ray warning lamps
3. Trigger for the acquisitor, to receive data from the DMS
4. Start sequence is initiated by the MANUAL button on the control scan unit which sends the signal Startkey to the MCU-MCB.
5. MCU activates the main trigger, XC enable (X-ray continuous enable), which is gated with XCEN_FW (X-ray continuous enable Firmware), to synchronize the tube position with the start position.
6. The start position for the scan is determined by the LPS_CON logic, which activates RotPos_OK (Rotate position ok). XC_Gen (X-ray continuous generate) is transmitted to the generator via the ACU, to start high voltage.

In addition the SCAN START can occur from:

- Pulmo trigger
- Cardio trigger

The ACU reads XC_Gen and ends the offset measurements.

When X rays are on, the generator outputs X rays, which, in turn, sets the X-ray warning lamps in: the MCR/RTC, the DCC, the GPC at the front panels in the Scan Control Unit and informs the Acquisitor.

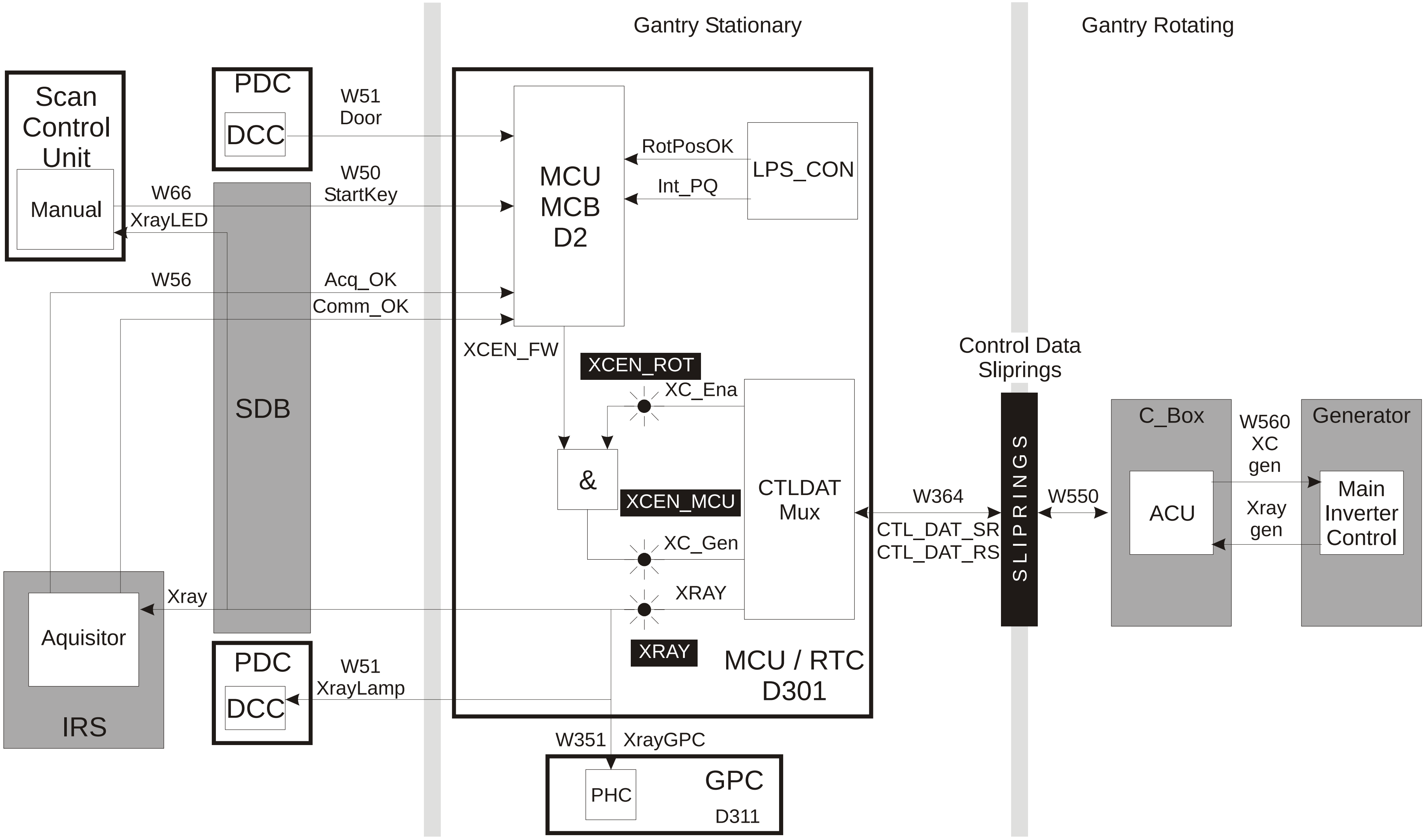

Gantry Stationary
Gantry Rotating
Scan Control Unit
Manual
PDC
DCC
W51
Door
W50
StartKey
W66
XrayLED
SDB
W56
Acq_OK
Comm_OK
MCU
MCB
D2
RotPosOK
Int_PQ
LPS_CON
XCEN_FW
XCEN_ROT
XC_Ena
&
XCEN_MCU
CTLDAT
Mux
XC_Gen
XRAY
XRAY
MCU / RTC
D301
Xray
Aquisitor
IRS
PDC
DCC
W51
XrayLamp
W351
XrayGPC
PHC
GPC
D311
Control Data
Sliprings
SLIPRINGS
W364
CTL_DAT_SR
CTL_DAT_RS
W550
C_Box
ACU
W560
XC
gen
Xray
gen
Generator
Main
Inverter
Control

Figure 3-19: X-ray Control

Patient Table Interface

The MCU-MCB serves as an interface for the Patient Handling System (PHS).

The PHS consists of two functional groups:

- PTH (D701) patient table horizontal
- PTV (D702) patient table vertical

Both the PTH and the PTV have their own MCB, which is connected, via the CAN-bus (COMM-lines), to the MCU-MCB and both are:

- Hardwired to the stop report loop
- Hardwired to the stop loop

The PTH transmits the HTP (Horizontal Table Pulse) control signal via the MCU/RTC and the control data sliprings to the ACU for timing control.

The Scan Control Unit sends a MOVE command to the MCU-MCB, via the SDB, when the table should be moved horizontally by the operator.

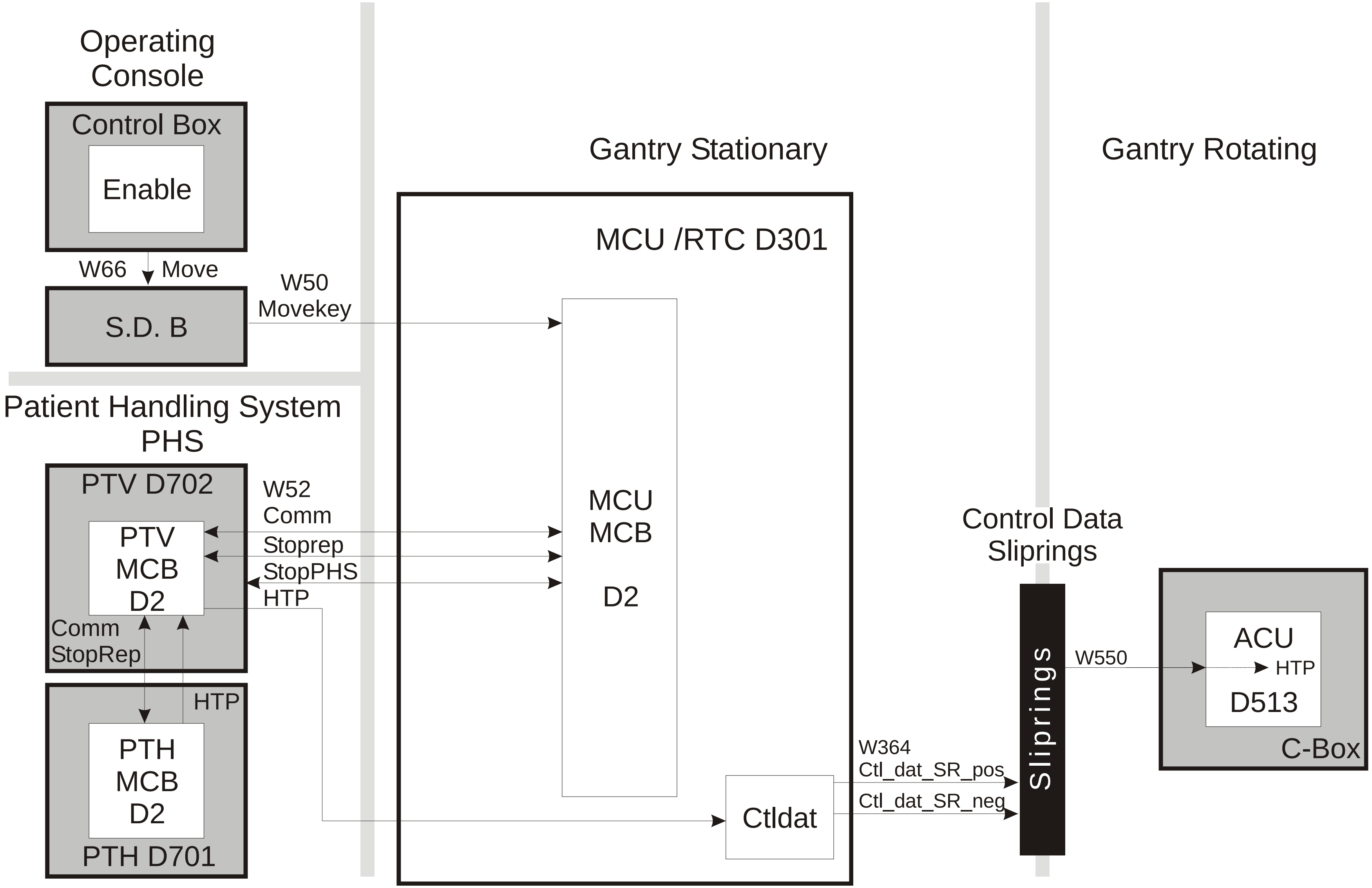

Operating Console
Control Box
Enable
W66
Move
S.D. B
W50
Movekey
Gantry Stationary
Gantry Rotating
MCU /RTC D301
MCU
MCB
D2
Patient Handling System
PHS
PTV D702
PTV
MCB
D2
W52
Comm
Stoprep
StopPHS
HTP
Comm
StopRep
HTP
PTH
MCB
D2
PTH D701
Ctldat
W364
Ctl_dat_SR_pos
Ctl_dat_SR_neg
Control Data Sliprings
Sliprings
W550
ACU
HTP
D513
C-Box

Figure 3-20: Patient Handling System

System Interface

The Imaging System is connected to the MCU/RTC, and the Scan Control Unit (via the S.D.B.).

The Imaging System consists of two functional groups: The Host and the Image Reconstruction System (IRS)

- The Host is connected to the MCU/RTC:
  - From the CIB CAN Interface Board for CAN-BUS communication (COMM) and the stop-report loop
  - From the Scan Control Unit for the loudspeaker-and microphone lines
  - From the eight Serial Interfaces for the option control signals:
    - ComPwrinjector for injector control
    - ComPulmo for pulmo control
    - NoiseCancel for the noise suppression of the microphone signals from the Gantry

- The IRS is connected to the MCU/RTC with the following signals:
  - Comm-ok: indicates that communication to the Acquisitor board is ok
  - Acq-ok: indicates that Acquisition is ok
  - Trigger_In1
  - Trigger_In2
  - En_Ac q_ok
  - X-ray: indicates, to the Acquisitor, that X rays are switched on by the generator.

The Scan Control Unit is connected to the MCU/RTC with the following signals:

- Start: to start a measurement
- Enable: to move the patient table horizontally
- Pause Hold Measurement: to interrupt a scan sequence
- X-ray: to switch the X ray warning lamp on the Control Box on, when X rays are on
- StopRep: Stop Report Loop is fed through the Scan Control Unit, to open it with the stop push-button on the Control Box

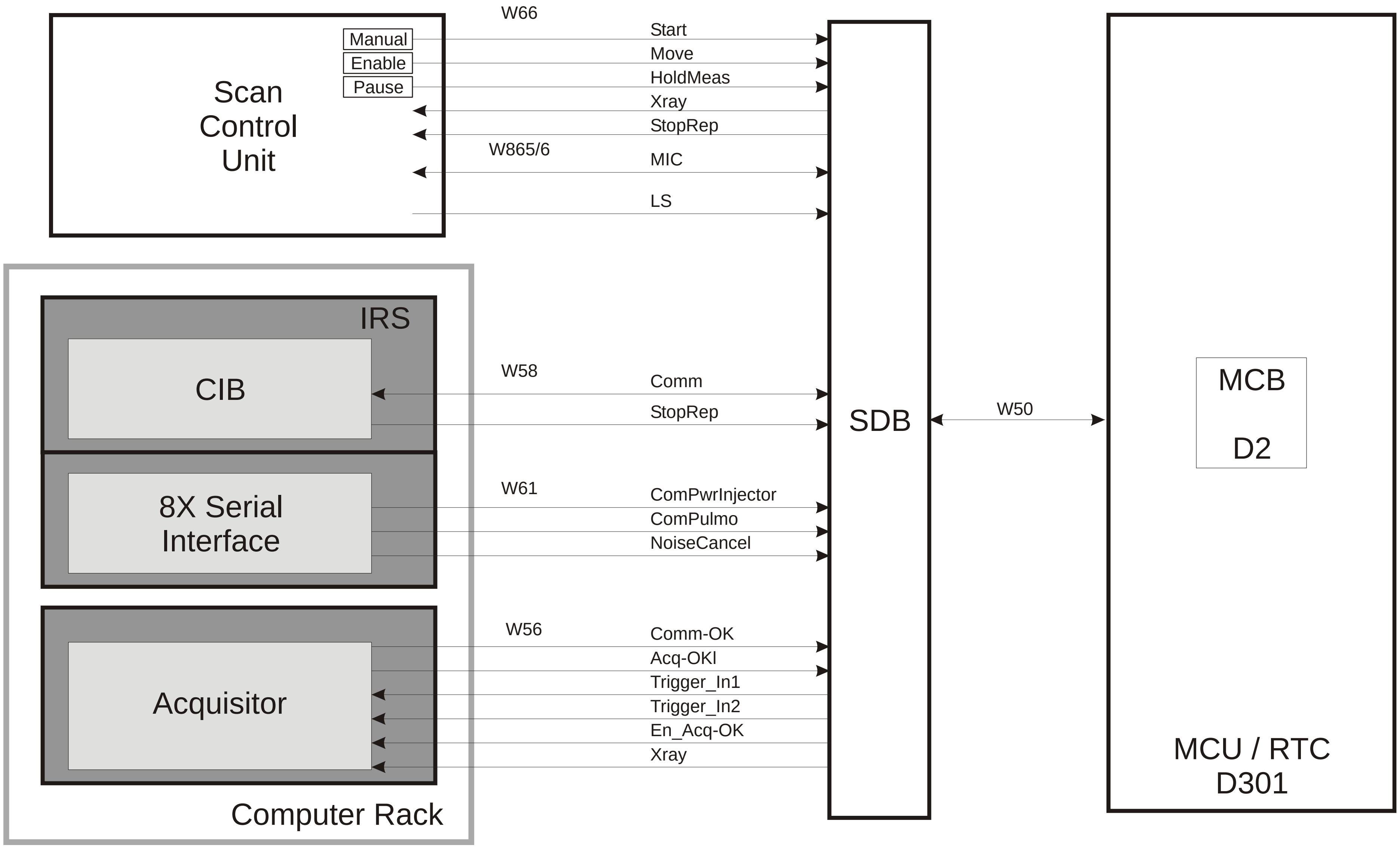

Scan Control Unit
Manual
Enable
Pause
W66
Start
Move
HoldMeas
Xray
StopRep
W865/6
MIC
LS
IRS
CIB
W58
Comm
StopRep
8X Serial Interface
W61
ComPwrInjector
ComPulmo
NoiseCancel
Acquisitor
W56
Comm-OK
Acq-OKI
Trigger_In1
Trigger_In2
En_Acq-OK
Xray
Computer Rack
SDB
W50
MCB
D2
MCU / RTC
D301

Figure 3-21: System Interface

Power Supply Stationary

The function of the Power Supply Stationary (PSS) is as follows:

- The PSS is the input terminal and internal distribution unit for power in the Gantry. The PSS receives three-phases of 230 V, neutral and protective earth from the Power Distribution System (PDS) in the Power Distribution Cabinet (PDC), and supplies all stationary components with power.
- The PSS receives the UDC-voltage from the Direct Current Circuit (DCC) in the PDC and connects line voltage and UDC-voltage through the sliprings to the rotating part of the Gantry.
- The 230 V required to supply the Patient Handling System (PHS) is passed through the PSS.

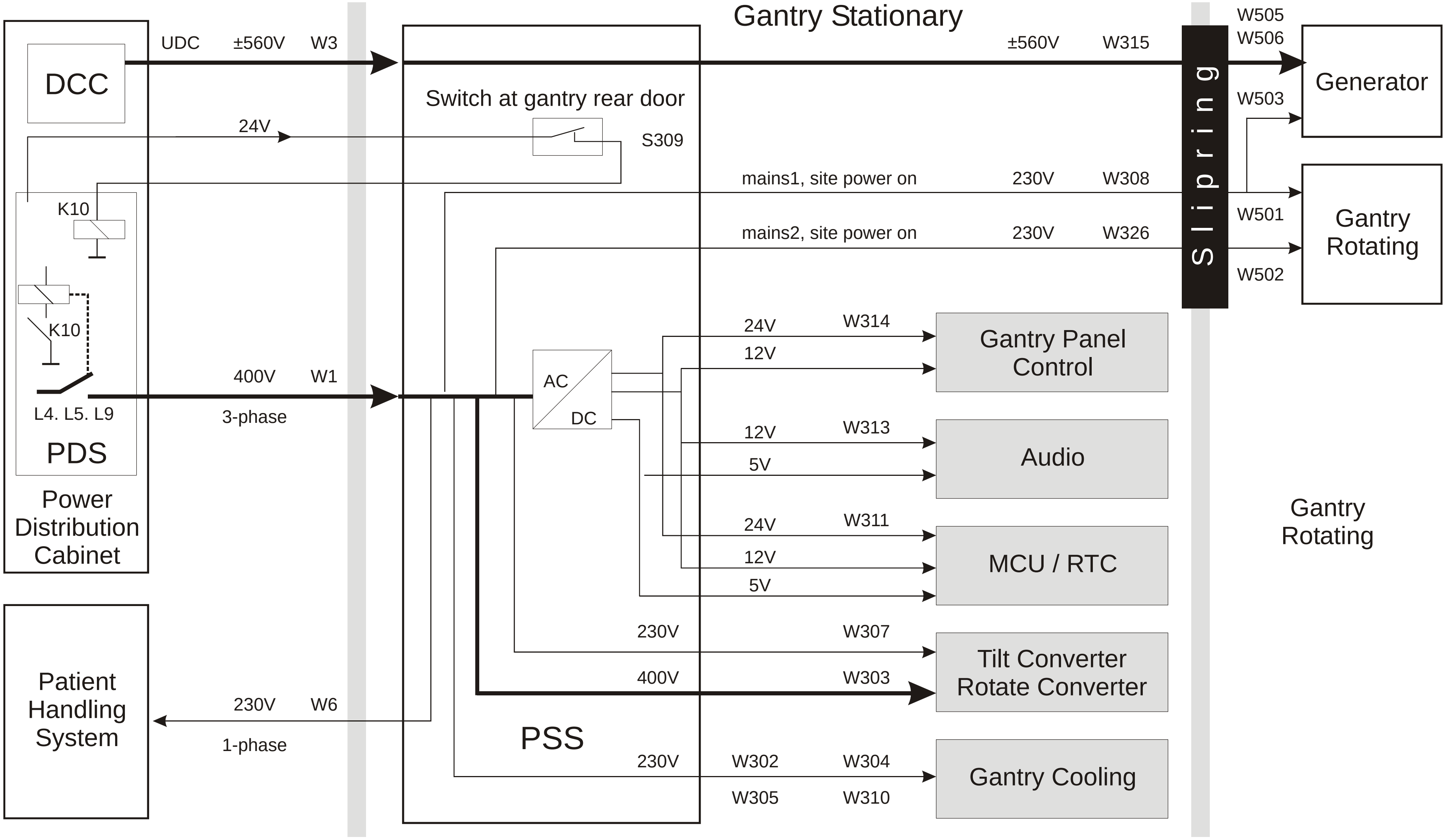

Gantry Stationary
DCC
UDC
±560V
W3
24V
Switch at gantry rear door
S309
K10
K10
400V
W1
3-phase
L4. L5. L9
PDS
Power Distribution Cabinet
Patient Handling System
230V
W6
1-phase
AC
DC
PSS
±560V
W315
mains1, site power on
230V
W308
mains2, site power on
230V
W326
S l i p r i n g
W505
W506
W503
W501
W502
Generator
Gantry Rotating
24V
W314
12V
Gantry Panel Control
12V
W313
5V
Audio
24V
W311
12V
5V
MCU / RTC
230V
W307
400V
W303
Tilt Converter Rotate Converter
230V
W302
W304
W305
W310
Gantry Cooling
Gantry Rotating

Figure 3-22: PSS Block Diagram

Phases Description

From the Power Distribution System (PDS), three phases of 230 V, and neutral and protective earth are connected to the Power Supply Stationary (PSS). In the PDS, the phases are switched with K4 relay corresponding to the following states:

off	K4 open
system-on	K4 closed
computer-on	K4 open

The B305 Temperature Sensor is included in the K4 circuit. As a result, the Gantry is powered off if its air temperature exceeds 43°C (109.4°F).

In the PDS, one phase (L2) is split and passes through the Gantry to supply the PHS.

Additionally, L2 is also connected as the permanent Power Supply Mains2 through the sliprings to the rotating part of the Gantry. Here L2 is used for the detector heating. In the PSS, Mains2 is protected by F309, passes the S309 xxx switch and is filtered from Z305.

NOTE:

Mains2 is derived from L2 in the PDS without passing K4. In this way, the 230 V supply voltage for the heating detector is immediately available, if the external three-phase power connection for the PDS is switched on.

A second 230 V supply for the rotating part of the Gantry, called Mains1, is derived from L3, filtered from Z301, Z303 and protected from F306. This 230 V supply is controlled from K4 only in when the system is on.

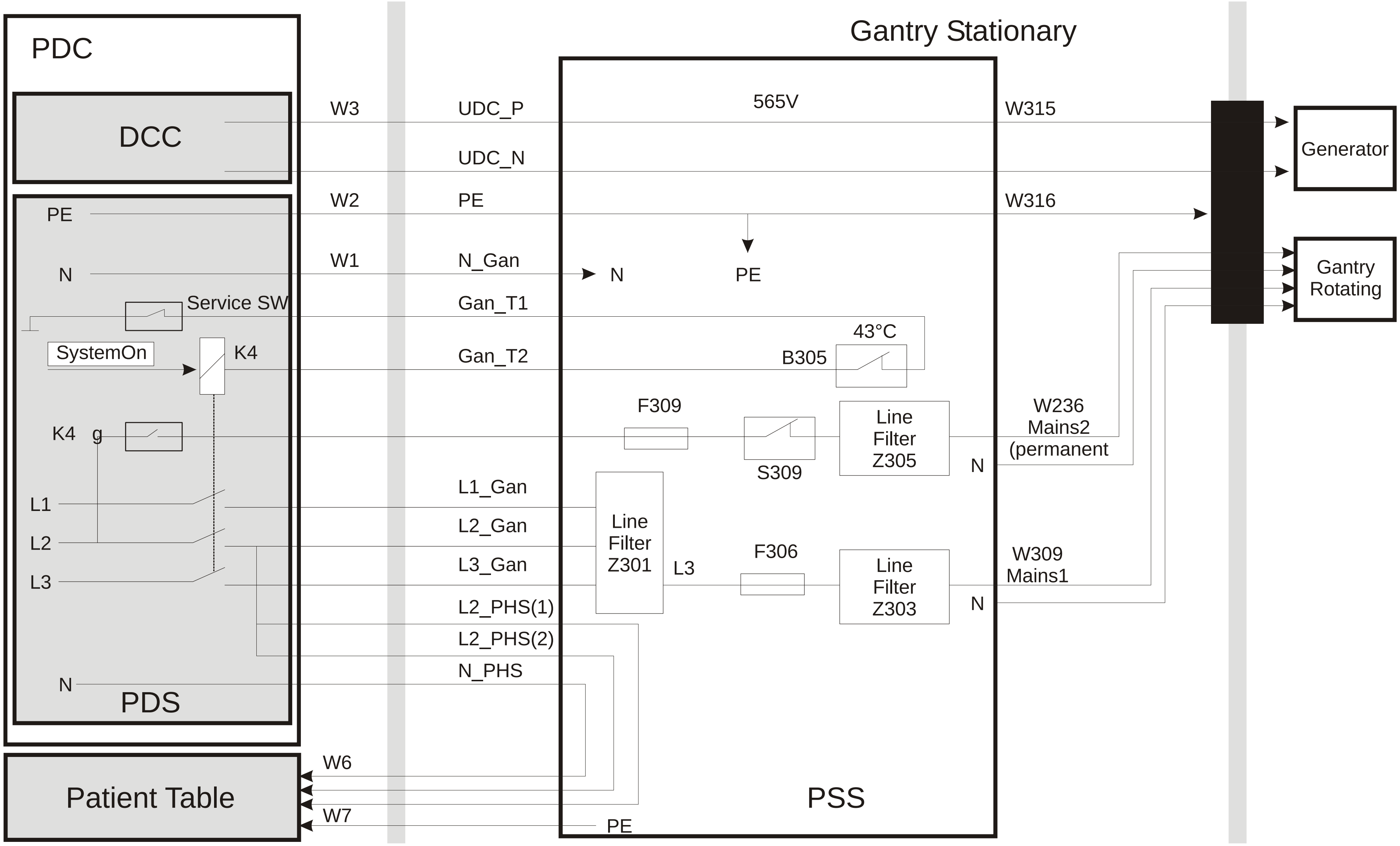

PDC
DCC
PDS
Patient Table
Gantry Stationary
PSS
Generator
Gantry Rotating
W3
UDC_P
565V
W315
UDC_N
W2
PE
W316
PE
W1
N_Gan
N
N
PE
Service SW
Gan_T1
43°C
SystemOn
K4
Gan_T2
B305
F309
K4
g
S309
Line Filter Z305
W236
Mains2
(permanent
N
L1_Gan
L1
L2_Gan
L2
L3_Gan
L3
Line Filter Z301
L3
F306
Line Filter Z303
W309
Mains1
N
L2_PHS(1)
L2_PHS(2)
N_PHS
N
W6
W7
PE

Figure 3-23: Phases Description

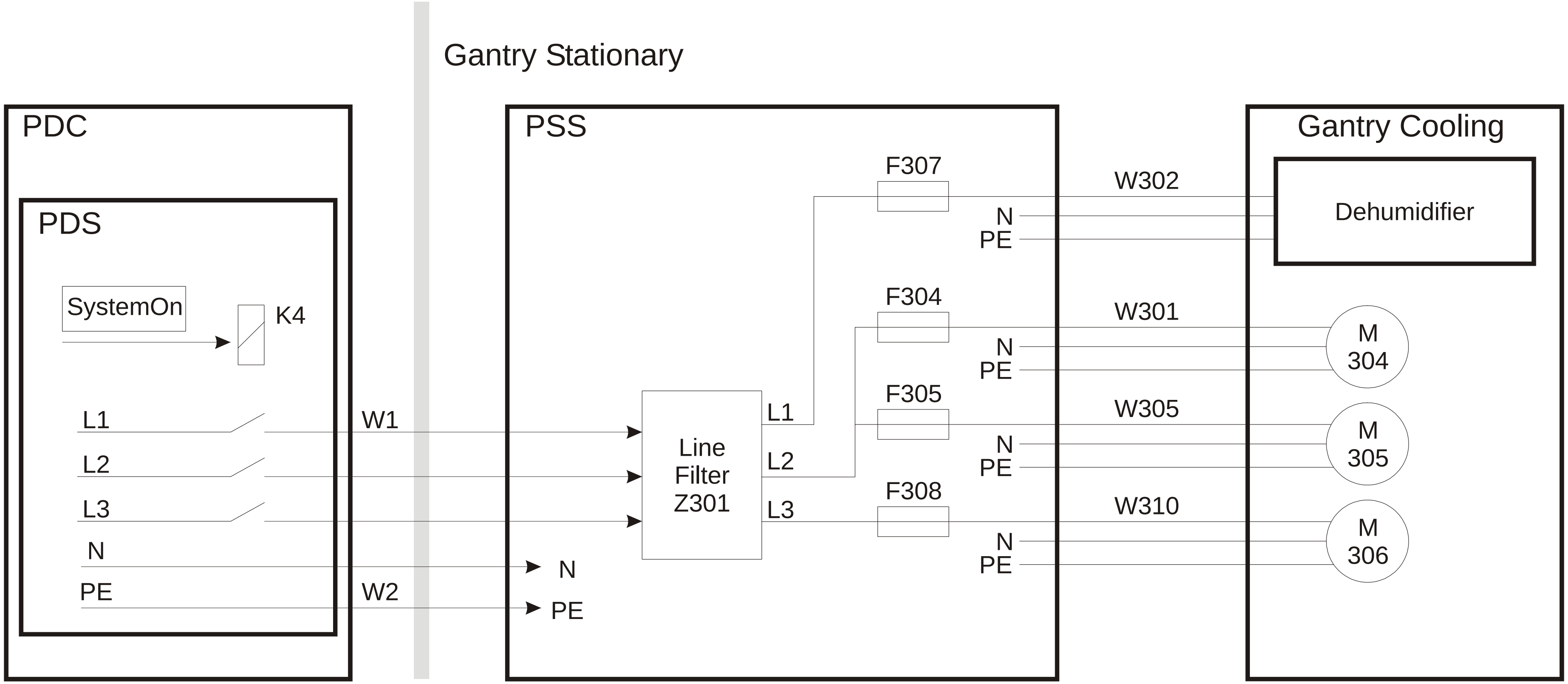

Gantry Stationary
PDC
PDS
SystemOn
K4
L1
L2
L3
N
PE
W1
W2
PSS
Line Filter Z301
L1
L2
L3
N
PE
F307
F304
F305
F308
N
PE
W302
W301
W305
W310
Gantry Cooling
Dehumidifier
M 304
M 305
M 306

Figure 3-24: Phases Description

Three phases of 230 V, controlled from K4, are connected to the Z301 filter in the PSS from the PDS. Phase L1, fused with F307, is used to drive the dehumidifier.

Phase L2 supplies the two fans, M304 and M305 for the Gantry cooling. The third fan, M306, is driven from phase L3. These fans are permanently running in the system-on state.

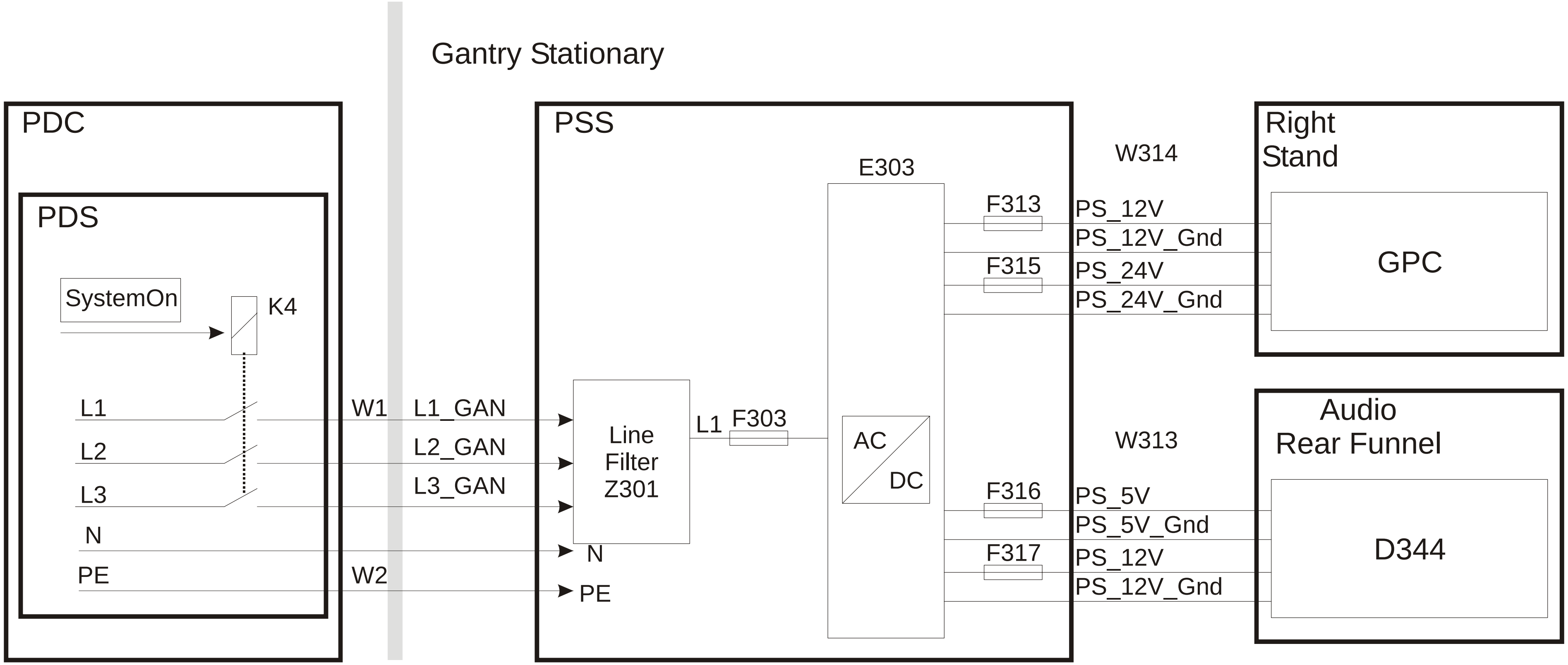

Gantry Stationary
PDC
PDS
SystemOn
K4
L1
L2
L3
N
PE
W1
W2
L1_GAN
L2_GAN
L3_GAN
PSS
Line Filter Z301
N
PE
L1
F303
E303
AC
DC
F313
F315
F316
F317
W314
PS_12V
PS_12V_Gnd
PS_24V
PS_24V_Gnd
Right Stand
GPC
W313
PS_5V
PS_5V_Gnd
PS_12V
PS_12V_Gnd
Audio Rear Funnel
D344

Figure 3-25: Phases Description

Controlled from K4 in the Power Distribution System (PDS), phase L1 is connected to the Z301 filter in the Power Supply Stationary (PSS) and through F303 to the E303 Low Voltage Power Pack. This is a multiple power supply, that generates 5 V, 12 V and 24 V.

The Gantry Panel Controller (GPC) is supplied with 12 V and 24 V. The D344 Audio Board receives 5 V and 12 V.

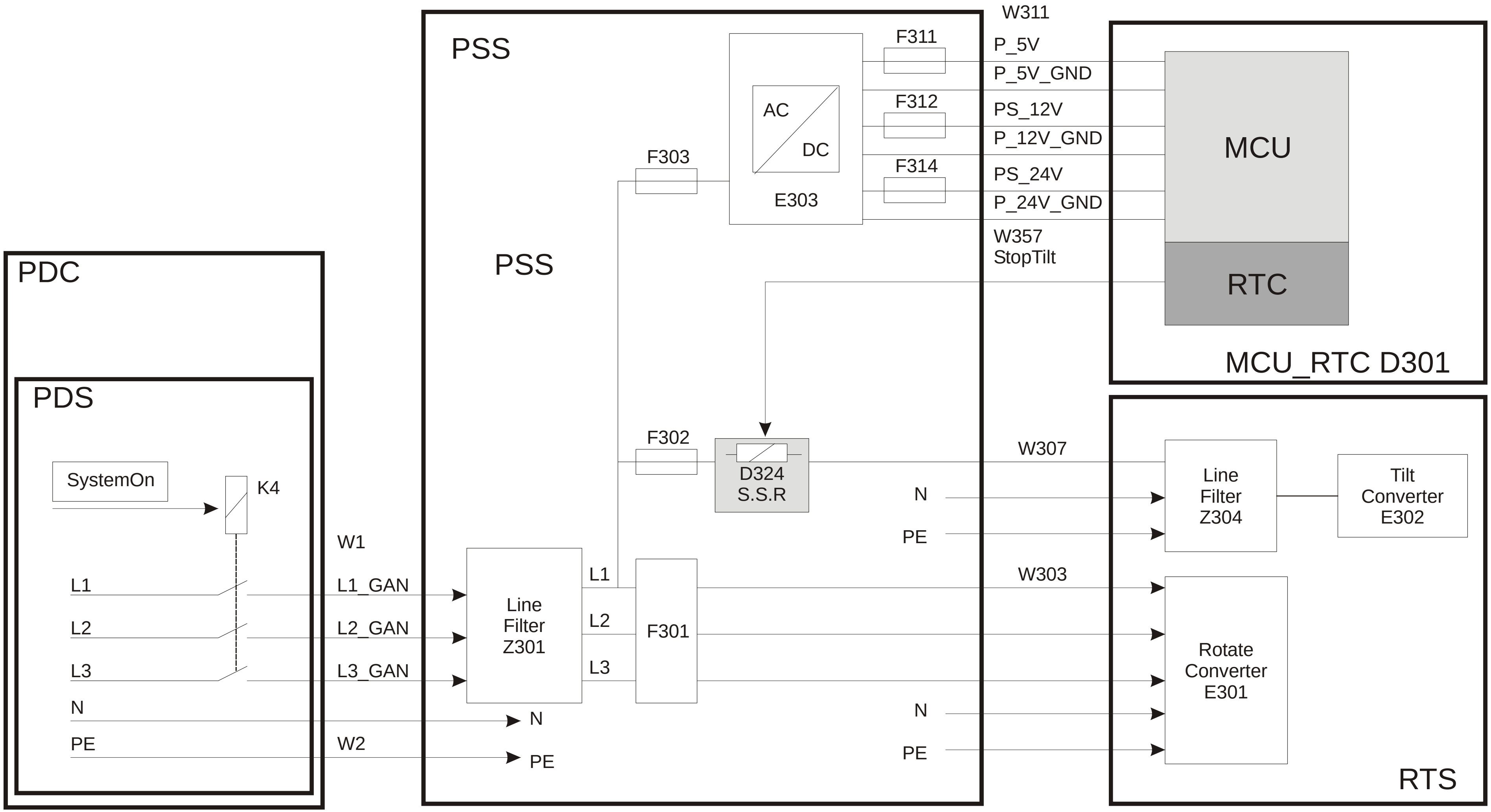

PSS
PSS
AC
DC
E303
F303
F311
F312
F314
W311
P_5V
P_5V_GND
PS_12V
P_12V_GND
PS_24V
P_24V_GND
W357
StopTilt
MCU
RTC
MCU_RTC D301
PDC
PDS
SystemOn
K4
L1
L2
L3
N
PE
W1
L1_GAN
L2_GAN
L3_GAN
W2
Line Filter Z301
L1
L2
L3
N
PE
F301
F302
D324 S.S.R
W307
N
PE
W303
N
PE
Line Filter Z304
Tilt Converter E302
Rotate Converter E301
RTS

Figure 3-26: Phases Description

Three phases of 230 V are connected to the Z301 filter in the Power Supply Stationary (PSS) and are controlled from K4 in the Power Distribution System (PDS).

Phase L1, fused with F303, drives the E303 low voltage power pack. This is a multiple power supply that generates 5 V, 12 V and 24 V; all being connected to the D301 MCU/RTC board.

Also, phase L1 is connected to the E302 Single-Phase Frequency Converter to drive the tilt motor. The input voltage is protected with F302, filtered by Z304 and can be interrupted with the D324 Solid State Relay whenever the signal Stop Tilt is set from the Rotate Tilt Controller (RTC).

To drive the rotate motor, L1, L2, and L3 are connected to the E301 Three-Phase Frequency Converter. All three phases are protected with F301 and filtered from Z301. In the stop state, rotation has to be finished as soon as possible. This is done by disconnecting the output of the frequency converter from the rotate motor and connecting the braking resistors to the motor.

Gantry Stationary Diagnostics and Troubleshooting

This section describes tests and troubleshooting for the following, in the order listed:

- The MCU_MCB board (MCU D2 on MCU_RTC D301).
- The RTC_MCB board (RTC D2 on MCU_RTC D301)
- The GPC board (D311)

In addition, the following section is included:

- Verifying Correct Water Hose Connections in the Gantry

Testing the MCU_MCB Board

Test the MCU_MCB board (MCU D2 on MCU_RTC D301) as follows:

1. Press the **Start** button twice. The test ends automatically.
2. Press the footswitch twice. The test ends automatically.
3. Activate the external trigger twice. The test ends automatically.
4. If the **Stop Report Loop** does not close, press the S10 switch on the MCU_RTC board (D301). This should bridge the K1 connector and supply 24 V (30 mA) to the **Stop Report Loop**.

Another way to test the **Stop Report Loop** is to check the voltage of each controller diode. To do this, connect the two pins shown for each cable in *Table 3-13* on the connector indicated and check that the power corresponds the power shown.

NOTE:

- Switch the system to EVA ON when plugging in or unplugging connectors.
- During measurement, switch ON the system.

Table 3-13: Connectors for Testing Stop Report Loop

Cable	Connector	Connect these Pins		Controller	Power
		Pin	Pin		
W50	X13	3	19	ICS	1 V
W351	X3	3	7	GPC	1 V
W51	X14	3	7	PDC	1 V
W52	X16	3	7	PHS	2 V
	X21	2	6	option	Not used.
W362	X9	8	15	Stop button Gantry	Measure without power. 0 Ohm = OK

Testing the RTC_MCB Board

This section describes tests for the RTC_MCB board (RTC D2 on MCU_RTC D301).

Table 3-14 specifies the switches on the RTC_MCB board.

Table 3-14: RTC_MCB Switches

Switch	LED Color	Function	Comment
S11	Yellow	RTC service.	ON during service.
S2			
S3			

Frequency Converter (FC) Interface Rotation Test

During the Frequency Converter (FC) Interface Rotation test, the RTC_MCB board issues a signal and waits for acknowledgment from the LUST FC.

The FC is on the left leg of the Gantry. LEDs on the outside of the FC indicate the status of the FC and the error, if there is one (see *Table 3-15* and *Table 3-16*.)

To stop the test, press the **DONE** button.

NOTE:

- Ixt monitoring provides extra motor and inverter protection against high thermal loads.
- Within any ten minute period with a continuous current of I=1.fxIn (150% overload), an overload of one minute is permitted.

Table 3-15: FC Status Indicators

H1 (YELLOW)	H2 (GREEN)	MEANING
OFF	OFF	Power OFF, no function.
ON	OFF	Power ON, self-test after approximately 0.5 sec, inverter ready.
OFF	ON	Inverter started and in standby mode.
ON	ON	Overload protection and Ixt monitoring active.
Flashing	ON	Error. See *Table 3-16* for error description.

Table 3-16: Flashing H1 Errors

# OF FLASHES	ERROR	CAUSE	SOLUTION OR COMMENT
1	E-CPU	Error in CPU.	Switch system to COMP ON and SYS ON again.
2	E-OFF	Power OFF or voltage too low.	H1 flashes as long as UDC < 300 V.
2	E-EEP	Error in EEPROM.	Switch system to COMP ON and SYS ON again.
3	E-OC	Power ON, voltage too high or short circuit.	Check the drive and motor cables.
4	E-OV	Voltage too high.	Check the drive and the motor.
5	E-OLM	Motor overloaded or Ixt switched OFF.	Check the drive, the motor and ventilation.
6	E-OLI	Inverter overloaded, or Ixt switched OFF.	Check the drive and ventilation.
7	E-OTM	Motor too hot.	Thermistor protection option installed.
8	E-OTI	Inverter too hot.	Inverter overloaded.

Maximum Speed Limit Test

The Maximum Speed Limit test executes a rotation at a speed faster than the maximum permitted to test the 1% supervision of the rotation speed. Supervision is always active.

The test terminates automatically.

Angle Pulse (AP) Test

The angle pulse (AP) test evaluates the time interval between angle pulses. After rounding once, it displays the minimum and maximum time intervals for the appropriate angle positions. Twenty-four time intervals are displayed for balancing.

The test terminates automatically.

Frequency Converter (FC) Tilt Test

The frequency converter (FC) tilt test checks the interface with the FC during a Gantry tilt operation. During this test, the RTC_MCB board issues a signal and waits for acknowledgment from the FC.

To stop the test, press the **DONE** button.

Tilt Test

The tilt test checks the tilt function of the Gantry by tilting it to different positive and negative positions.

The test terminates automatically.

Testing the GPC Board

The CAN bus handles all communications that control or execute (Gantry Panel Control) GPC functions. All commands (e.g., tilt, table movement) from the operating panels or the GPC board (D311) are transmitted to the appropriate components or sub-assemblies via the CAN bus.

A CAN bus **ABORT** or **STOP/STOP REPORT** signal interrupts these communications.

The GPC board (D311) has the following LEDs: 5 V, 12 V and 24 V. It has no fuses or jumpers.

The GPC board has the following three measurement points:

- VCC

- GND
- COLLECTIVE ERROR (not used for service)

Table 3-17 specifies the switches on the GPC board.

Table 3-17: GPC Switches

SWITCH	DESCRIPTION
S01	Tilts the Gantry in a positive direction, forward.
S02	Tilts the Gantry in a negative direction, backward.
S03	Moves the Patient Table horizontally in a positive direction, away from the Gantry.
S10	Moves the Patient Table horizontally in a negative direction, toward from the Gantry.
S12	Moves the Patient Table vertically in a positive direction, downward.
S13	Moves the Patient Table vertically in a negative direction, upward.
S20	Moves the Patient Table from the outer light marker to the scan slice position.
S21	Moves the Patient Table away from the Gantry for patient loading or unloading.
S23	Resets horizontal position of the Patient Table to zero.
S30	Switches the light marker ON and OFF.
S31	Key test and LED test.
S32	Unused.
S41	Unused.
S42	Unused.

Verifying Correct Water Hose Connections in the Gantry

There are six water hose connections inside the Gantry.

- Three water hose connections for hot water—marked red
- Three water hose connections for cold water—marked blue

An incorrect connection causes overheating inside the Gantry. The purpose of this section is to instruct the FSE how to check for proper water hose connections in case overheating occurs.

Procedure

Water Hose Verification

Verify proper water hose connection as follows:

1. Move the couch MAX Down.
2. Turn the system OFF.
3. Open the Gantry front cover.
4. Check the water hose connections according to *Figure 3-27*, *Figure 3-28*, and *Figure 3-29*.

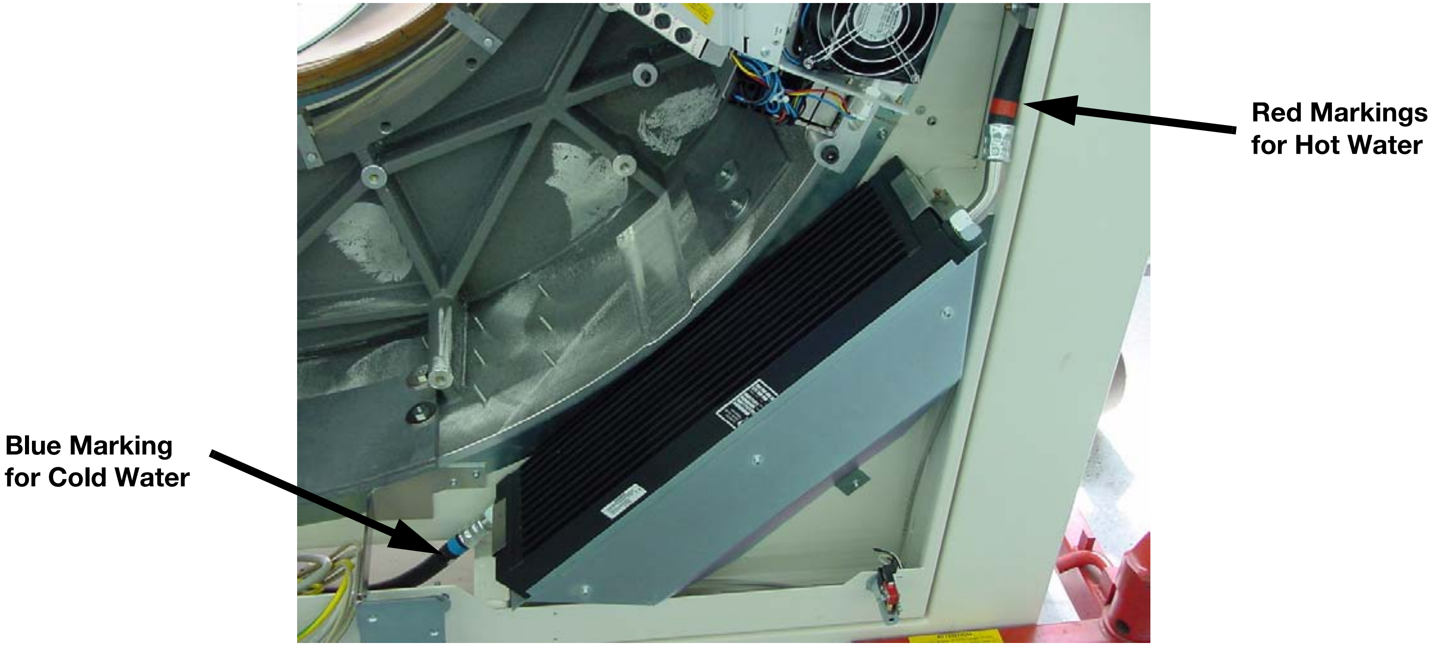

Red Markings
for Hot Water
Blue Marking
for Cold Water

Figure 3-27: Heat Exchanger—Lower Right

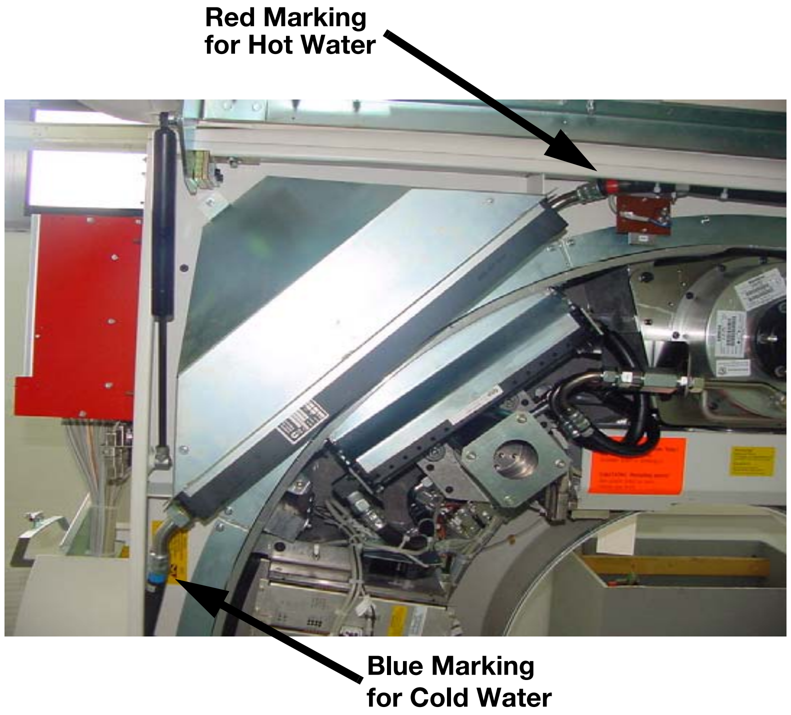

Red Marking
for Hot Water
Blue Marking
for Cold Water

Figure 3-28: Heat Exchanger—Upper Left

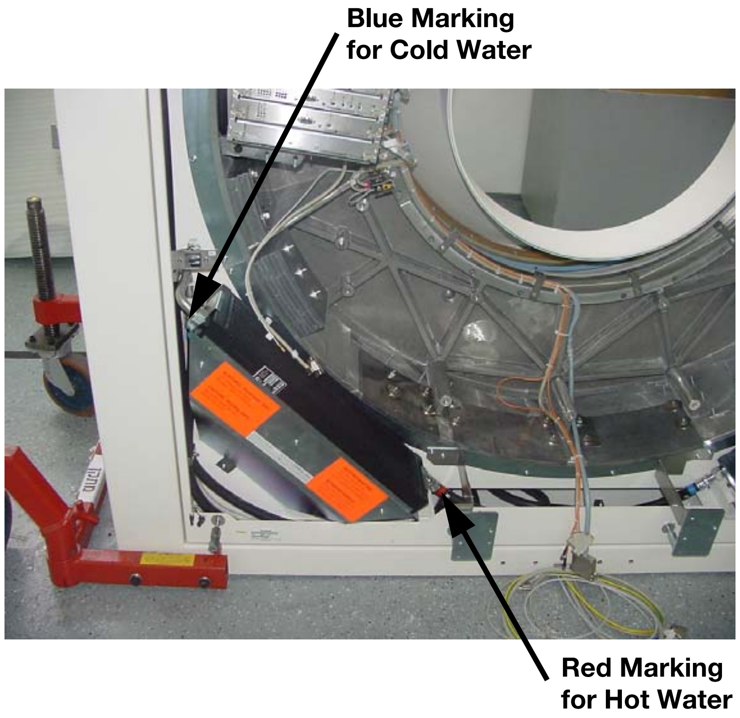

Blue Marking
for Cold Water
Red Marking
for Hot Water

Figure 3-29: Heat Exchanger—Lower Left

Water Hose Replacement in Case of Incorrect Positioning

⚠ WARNING ⚠

ELECTROCUTION HAZARD!! TURN OFF THE POWER TO THE GANTRY FROM THE MAIN POWER SWITCH.

1. Drain the system if there is water inside the cooling system as follows (see *Figure 3-30*):
   a. Connect the water hoses to the filling and draining valves.
   b. Route the water hoses to a syphon or a bucket.
   The end of the hose must be lower than the filling/draining valves for the water to drain completely from the cooling system.
   c. Open the filling and draining valves by turning them 90° counterclockwise using the valve cap. The valve is open when the notch on the valve is lined up with the connection pipe. The red shut-off valve for the Gantry cooling system must be open, i.e. the lever is lined up with the connection pipe. The cooling system is empty when water stops flowing from the water hoses.

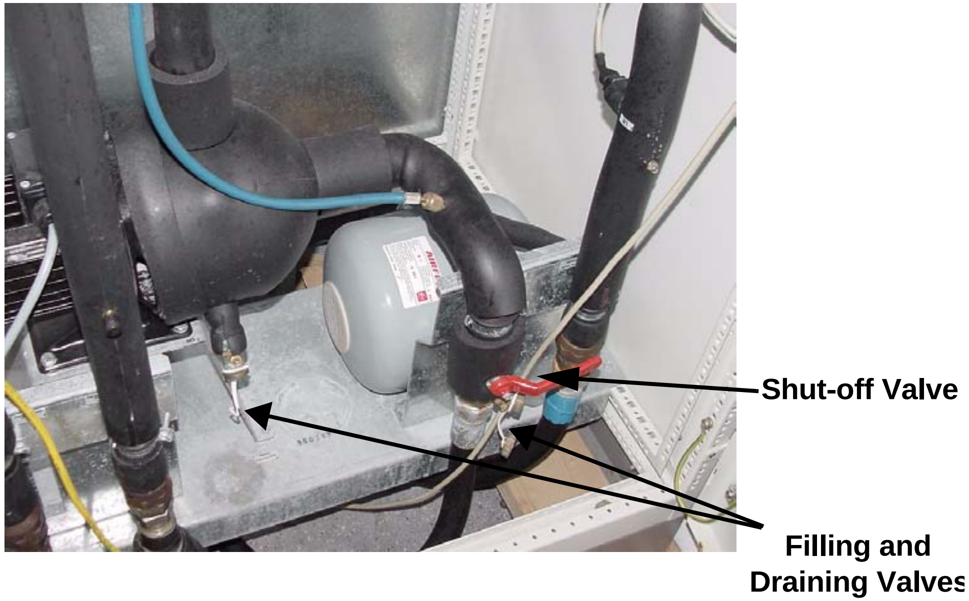


Figure 3-30: The Cooling System

2. Remove both cap nuts from the cooling hoses (see *Figure 3-31*).

> **NOTE:**
>
> Retain the hexagonal nut on the heat exchanger with the adjustable wrench.

3. Position the water hoses according to the figures shown above.
4. Tighten both cap nuts to a torque of 40 Nm.

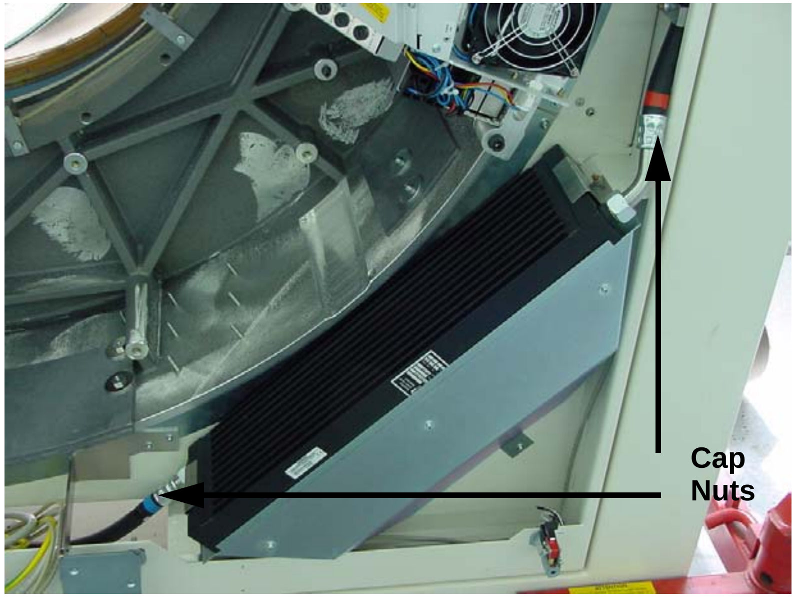


Figure 3-31: Heat Exchanger—Lower Right

Final Step

Refill the system and verify that there is no leakage from the hoses and that the Gantry does not overheat.

Gantry Stationary Parts Replacement

Overview

This section deals with the Gantry Stationary Replacement Parts.

Figure 3-32, *Figure 3-33*, *Figure 3-34*, and *Figure 3-35* show the location of the parts being replaced.

Left Side of the Gantry

The following parts shown in *Figure 3-32* are located on the left side of the Gantry:

- Rotating Frequency Converter (E301)
- Tilt Sensor (B301)
- Tilt Frequency Converter (E302)
- MCU_RTC board (D301)

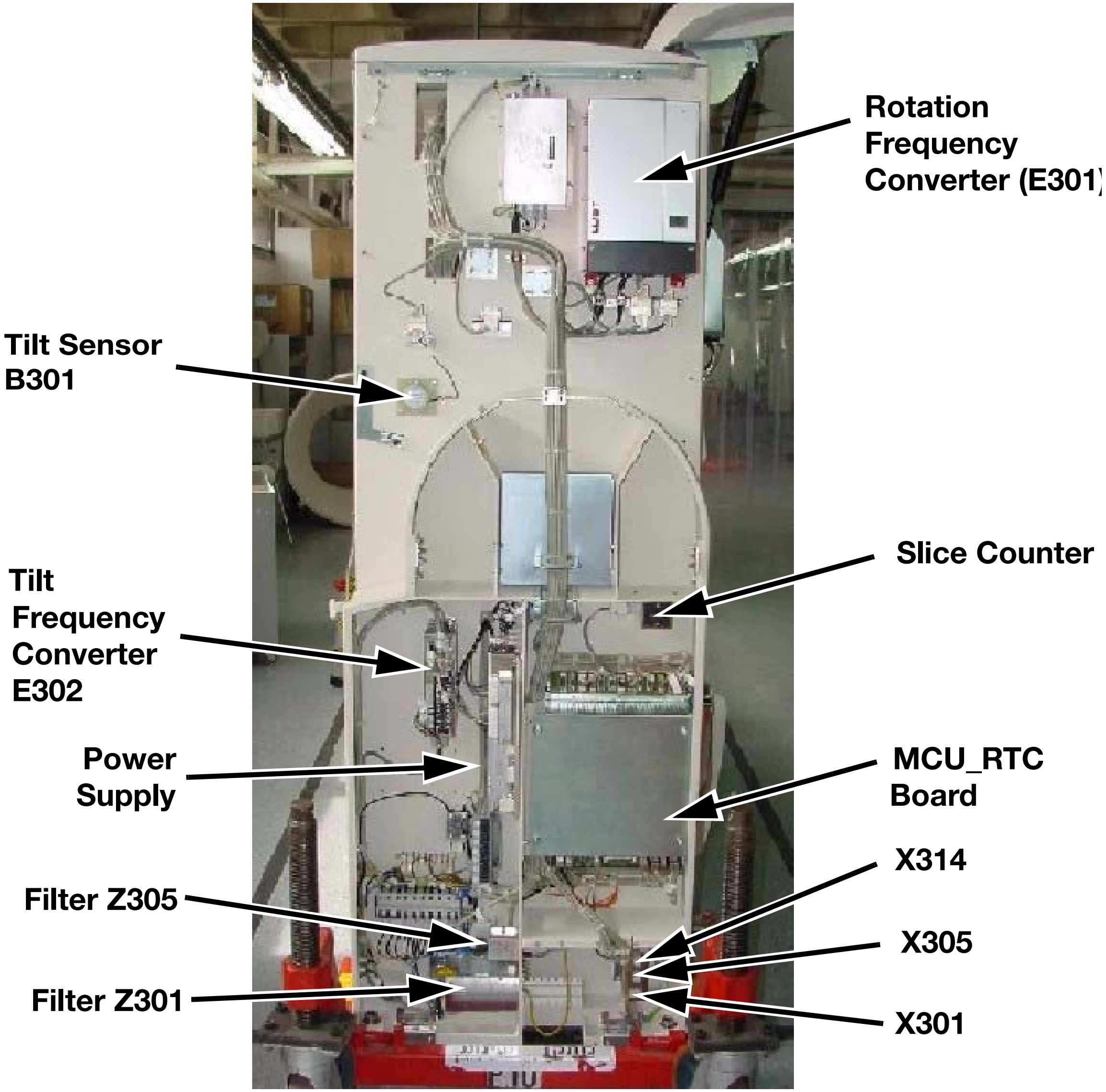

Rotation Frequency Converter (E301)
Tilt Sensor B301
Slice Counter
Tilt Frequency Converter E302
Power Supply
MCU_RTC Board
X314
Filter Z305
X305
Filter Z301
X301

Figure 3-32: Gantry Left Side

Right Side of the Gantry

The following parts shown in *Figure 3-33* are located on the right side of the Gantry:

- Dehumidifier
- GPC board (D311)
- Three-way valve
- Tilt Spindle

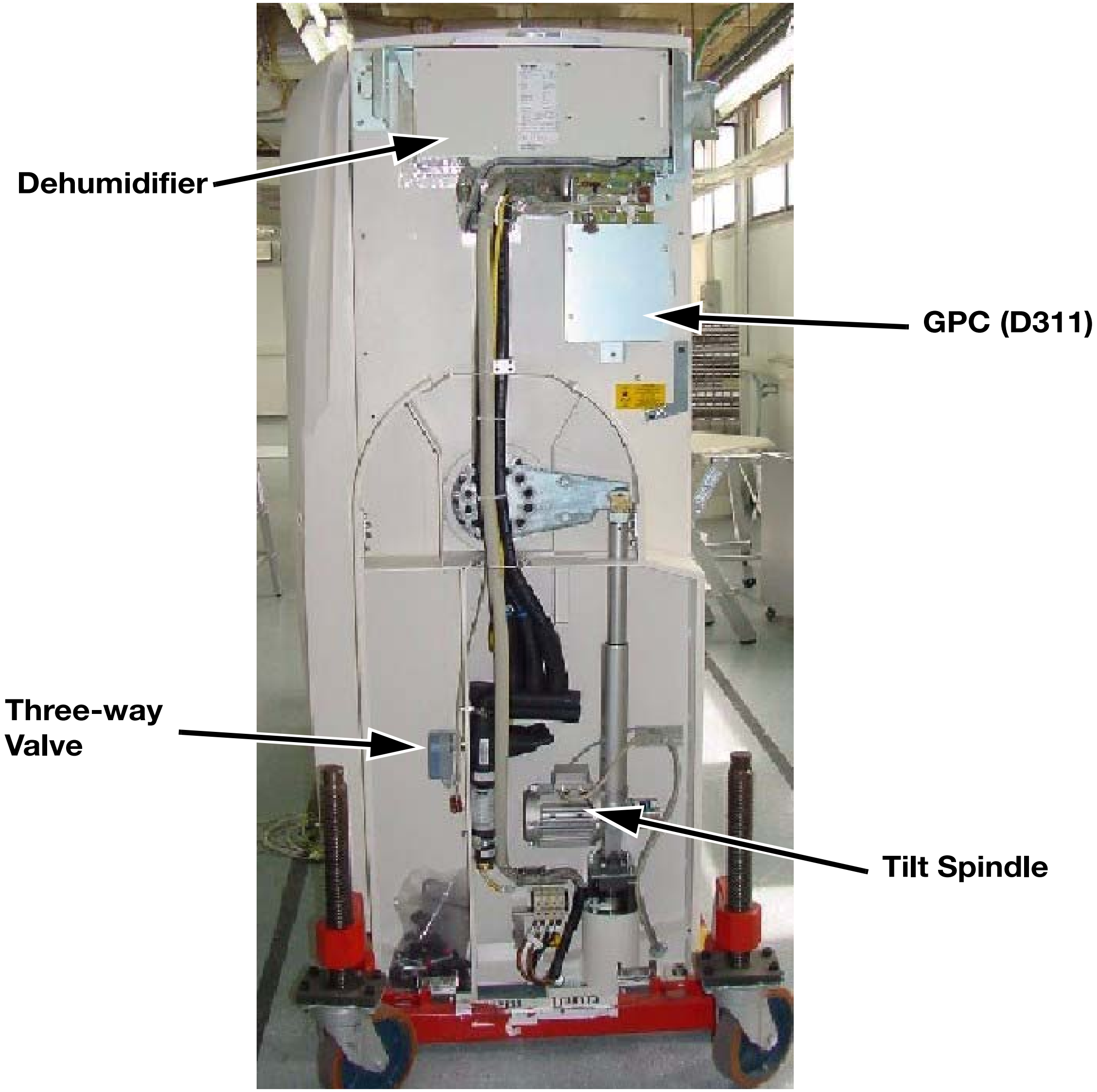

Dehumidifier
GPC (D311)
Three-way Valve
Tilt Spindle

Figure 3-33: Gantry Right Side

The following parts shown in *Figure 3-34* are located in the rear of the Gantry:

- Noise Cancellation board (D344)
- Brake Assembly (E322)
- Transmitter and Receiver boards
- Three fan covers
- Funnel (not shown in *Figure 3-34*)
- Slot Ring device

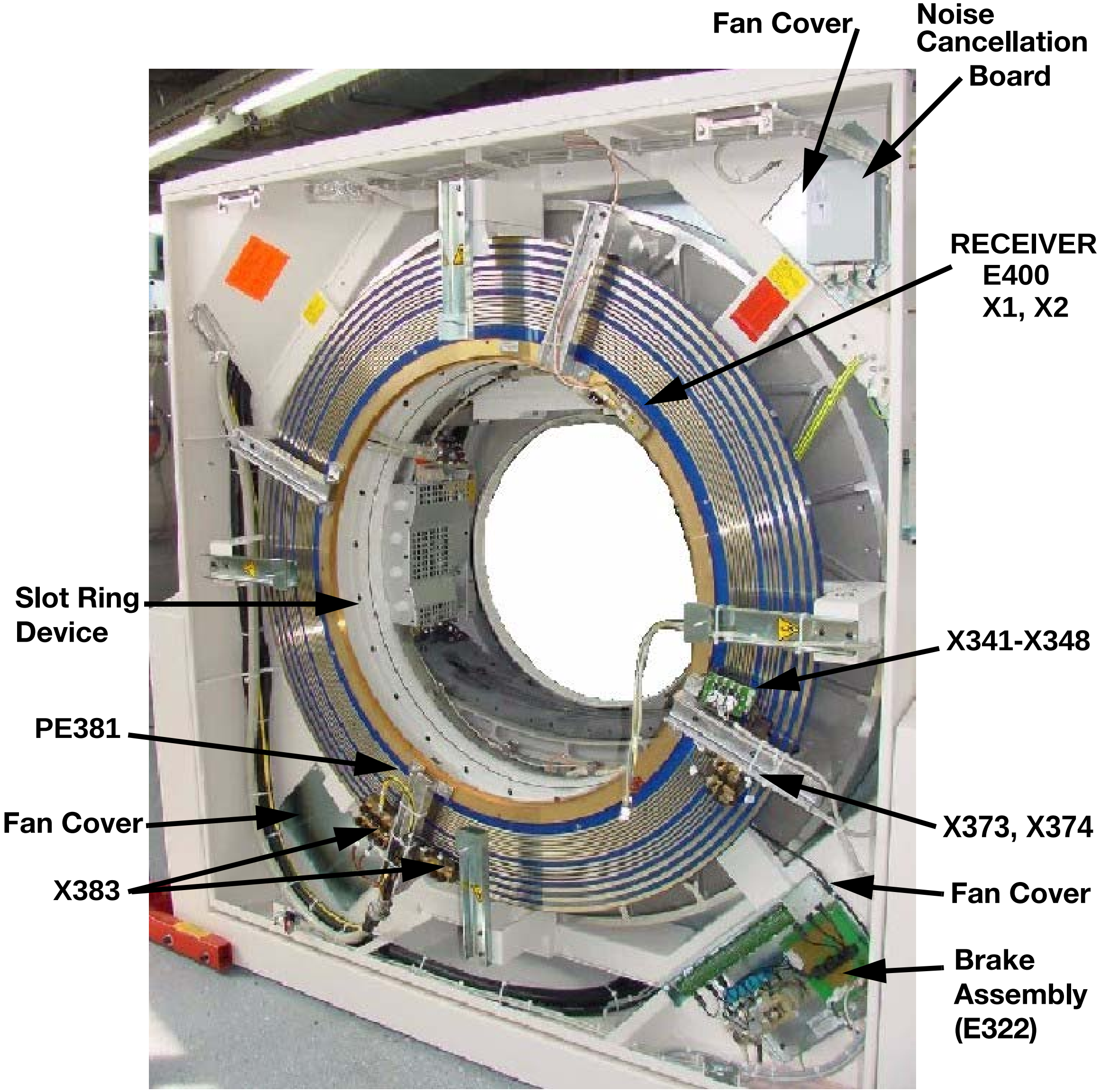

Fan Cover
Noise Cancellation Board
RECEIVER E400 X1, X2
Slot Ring Device
X341-X348
PE381
Fan Cover
X373, X374
X383
Fan Cover
Brake Assembly (E322)

Figure 3-34: Gantry Rear

The following part shown in *Figure 3-35* are located in the front of the Gantry:

Three heat exchangers

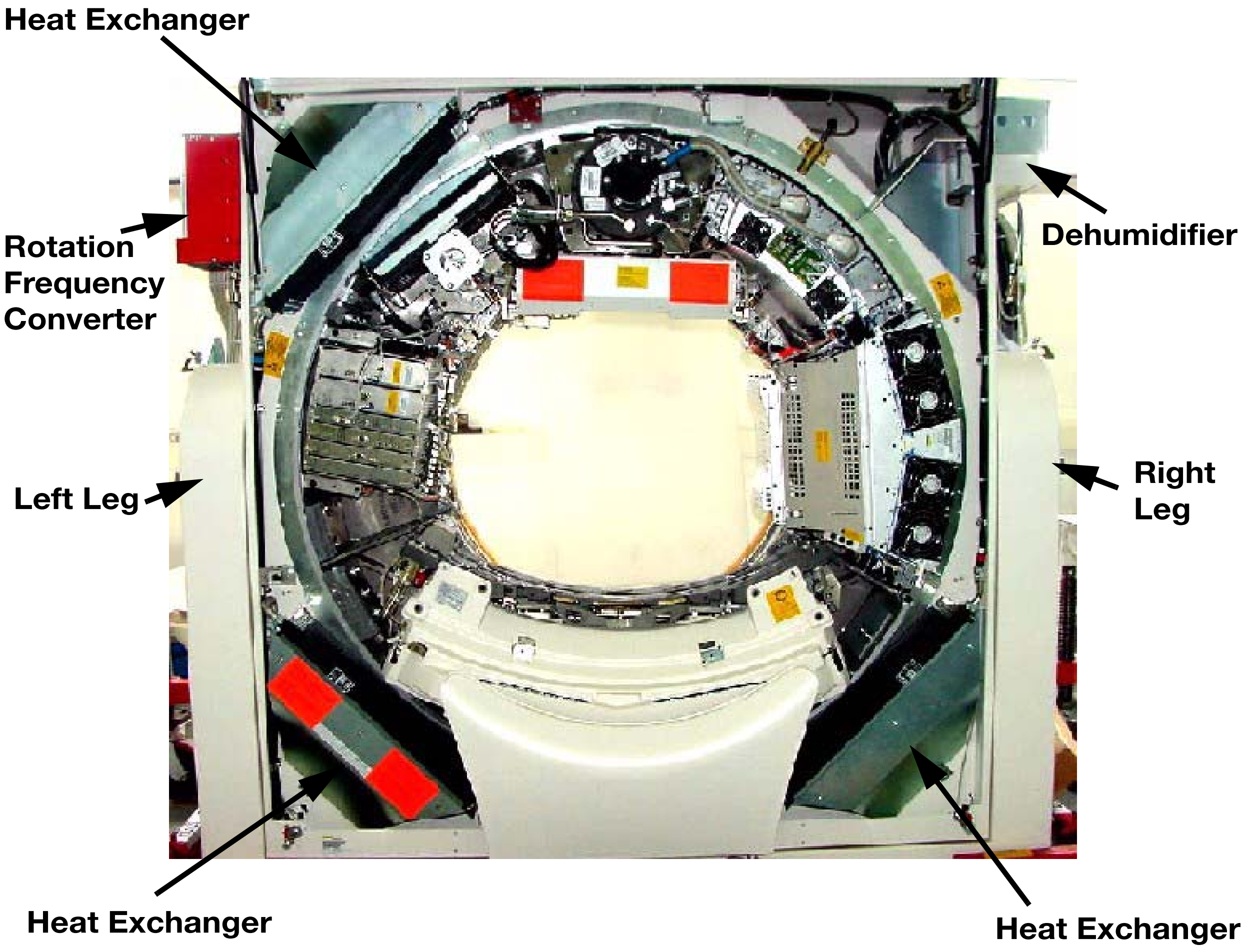

Heat Exchanger
Rotation Frequency Converter
Dehumidifier
Left Leg
Right Leg
Heat Exchanger
Heat Exchanger

Figure 3-35: Gantry Front

Replacing the Rotation Frequency Converter (E301)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to replace the rotation frequency converter.

Follow C-MOS guidelines, all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the rotation frequency converter as follows:

1. Remove the upper cover of the left side of the Gantry.
2. Loosen two screws (see *Figure 3-36*) and remove the cover of the rotation frequency converter.

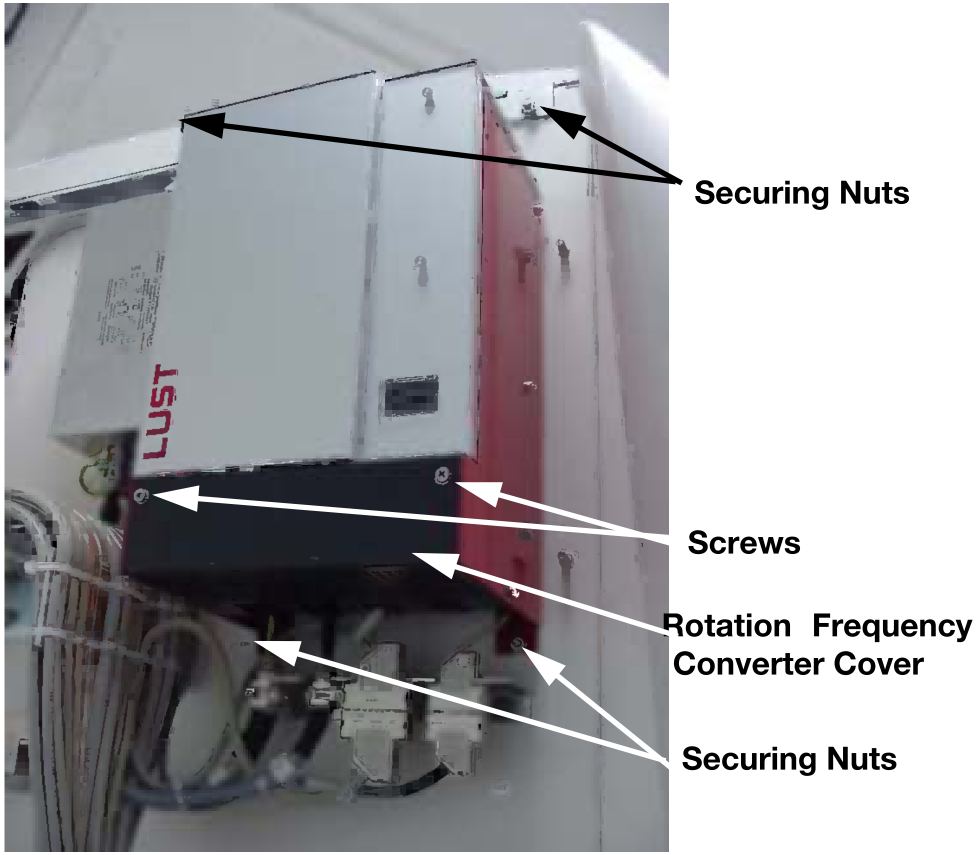
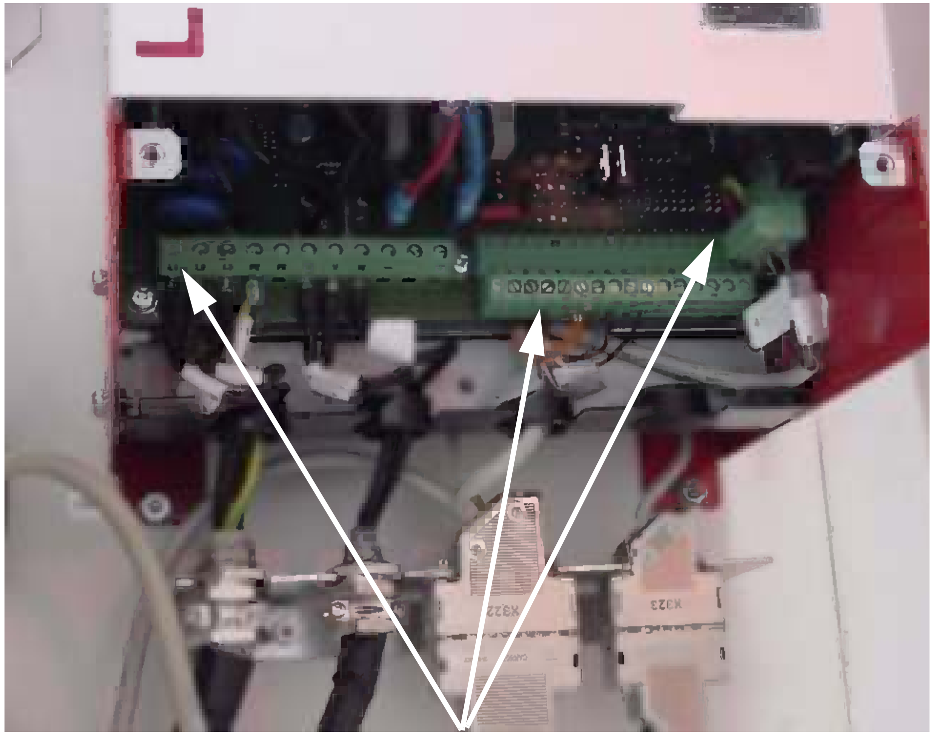

Securing Nuts
LUST
Screws
Rotation Frequency Converter Cover
Securing Nuts

Figure 3-36: Rotation Frequency Converter

3. Disconnect all wires from the three connection terminals (see *Figure 3-37*).
4. Loosen the two lower and two upper nuts indicated in *Figure 3-36*.
5. Remove the rotation frequency converter.
6. Insert the new rotation frequency converter and secure it in place with the four nuts you removed earlier (see *Figure 3-36*).
7. Connect all previously disconnected wires to the converter (see *Figure 3-37*).
8. Put the cover of the rotation frequency converter back in place (see *Figure 3-36*).
9. Turn the Gantry ON from the CT-Box.
10. Test the system in different rotation modes.
11. Put the upper cover of the left side of the Gantry back in place.



Connection Terminals

Figure 3-37: Rotation Frequency Convertor Connection Terminals

Replacing the Tilt Sensor

This section describes how to remove the old tilt sensor and install a new one in its place.

You need a standard service tool set to replace the tilt sensor.

Follow C-MOS guidelines, all general safety guidelines and radiation protection ordinances (*“Safety Guidelines”*).

WARNING

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the tilt sensor as follows:

1. Remove the upper cover of the left side of the Gantry.
2. Remove the old tilt sensor as follows:
   a. Disconnect connector X1 (shown in *Figure 3-38*).
   b. Remove the four set screws (shown in *Figure 3-38*).
   c. Remove the defective tilt sensor.
3. Install the new tilt sensor as follows:
   a. Insert the new tilt sensor.
   b. Insert and tighten the four set screws (shown in *Figure 3-38*).
   c. Connect connector X1 (shown in *Figure 3-38*).
4. Turn the Gantry ON from the CT-Box.
5. Adjust the tilt sensor as described in *“Adjusting the Tilt Sensor”*.
6. Install the cover of the left side of the Gantry.

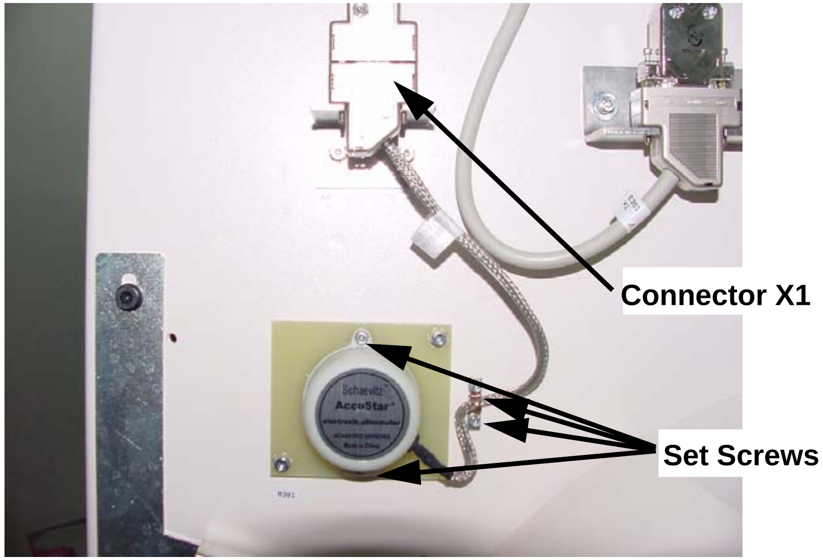


Figure 3-38: Tilt Sensor

Adjusting the Tilt Sensor

Although the tilt of the Gantry is adjusted in the factory, it must be adjusted again whenever the tilt sensor is replaced or whenever control measurement shows an inconsistency between the actual tilt angle and the display.

You need the following to adjust the tilt sensor:

- Screw driver
- Spirit level

Determining Whether Adjustment is Necessary

Before adjusting the tilt sensor, perform the following checks:

- Tilt the Gantry to the 0° position and use the level to check if the Gantry is exactly vertical. If it is not, perform the adjustment procedure.
- Tilt the Gantry to the +30° and -30° positions. If both end positions can be reached without hitting any mechanical end stop, no adjustment is necessary. Otherwise, perform the adjustment procedure.

Adjusting the Tilt Sensor

Perform the following procedure to adjust the tilt sensor:

1. Remove the upper and lower covers from the left leg of the Gantry.
2. Remove the cover from the MCU/RTC board.
3. Loosen two screws that hold the tilt sensor.
4. Turn the switch SERVICE RTC in *Figure 3-39* to the upward position.
5. Push the SERVICE STOP ON button.
6. Use S5 (TILT POS in *Figure 3-39*) and S6 (TILT NEG in *Figure 3-39*) to tilt the Gantry until it is vertical. Use a level to check it.
7. Rotate the tilt sensor in the upper mounting screw until the GPC display shows 00.0 ±0.2°.
8. Insert and secure both mounting screws. Be careful not to affect the adjustment of the tilt sensor.
9. Switch the SERVICE RTC switch in *Figure 3-39* to the downward position.
10. Install the upper and lower covers for the left leg of the Gantry.
11. Establish communication between the controllers by turning the Gantry OFF and then ON from the CT box.

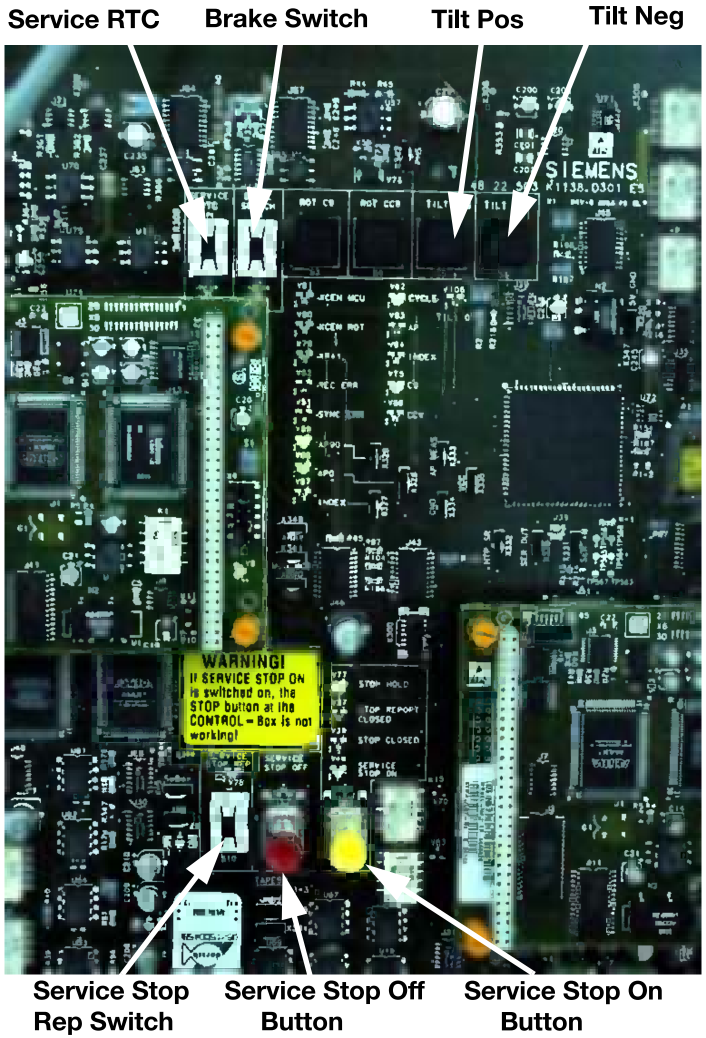

Service RTC
Brake Switch
Tilt Pos
Tilt Neg
SIEMENS
WARNING!
If SERVICE STOP ON is switched on, the STOP button at the CONTROL - Box is not working!
Service Stop Rep Switch
Service Stop Off Button
Service Stop On Button

Figure 3-39: Switches on the MCU Board

Replacing the Tilt Frequency Converter (E302)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to replace the tilt frequency converter.

Follow C-MOS guidelines, all general safety guidelines and radiation protection ordinances (see *"Safety Guidelines"*).

WARNING

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the tilt frequency converter as follows:

1. Remove the upper and lower covers of the left side of the Gantry.
2. Remove the screws from the clamps holding the cables connected to the power connector and connection terminals X1 and X5 (see *Figure 3-40*).
3. Remove the screws from connection terminals X1 and X5 and disconnect the cables.
4. Disconnect the power cable.
5. Remove the four nuts that retain the frequency converter.
6. Remove the old tilt frequency converter.
7. Insert the new tilt frequency converter and secure it in place with the four nuts you removed earlier (see *Figure 3-40*).
8. Install the connection terminals X1 and X5 and the power connector.
9. Tighten the screws on the clamps.
10. Install the lower and then the upper covers on the left side of the Gantry.
11. Turn the Gantry ON from the CT-Box.
12. Test the tilt functioning with the Gantry panels and by executing scans.

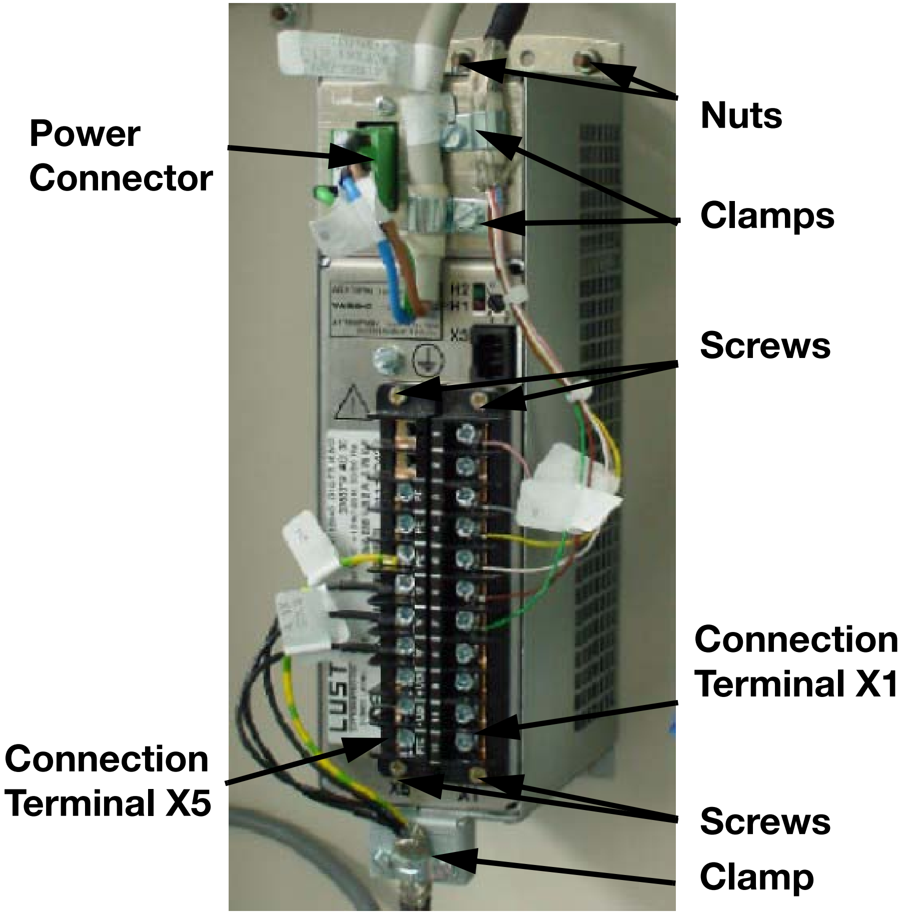


Figure 3-40: Tilt Frequency Converter

Replacing the MCU RTC Board (D301)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to replace the MCU RTC board.

Follow C-MOS guidelines, all general safety guidelines and radiation protection ordinances (see *"Safety Guidelines"*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the MCU RTC board as follows:

1. Remove the upper and then lower covers from the left side of the Gantry.
2. Remove the cover of the board (see *Figure 3-41*.
3. Disconnect all connectors from the upper and lower rows and cable X22.
4. Remove the twelve screws indicated in *Figure 3-41*.
5. Remove the two MCB D2 boards and the two screws located beneath each board.
6. Remove the old MCU RTC board.
7. Install the new MCU RTC board and secure it in place with the screws you removed earlier (shown in *Figure 3-41*).
8. Install the two MCB D2 boards and secure them with four nuts each.
9. Reconnect connectors according to the labels attached to them. Check that all connections are secure.
10. Put the cover of the MCU RTC board back in place.

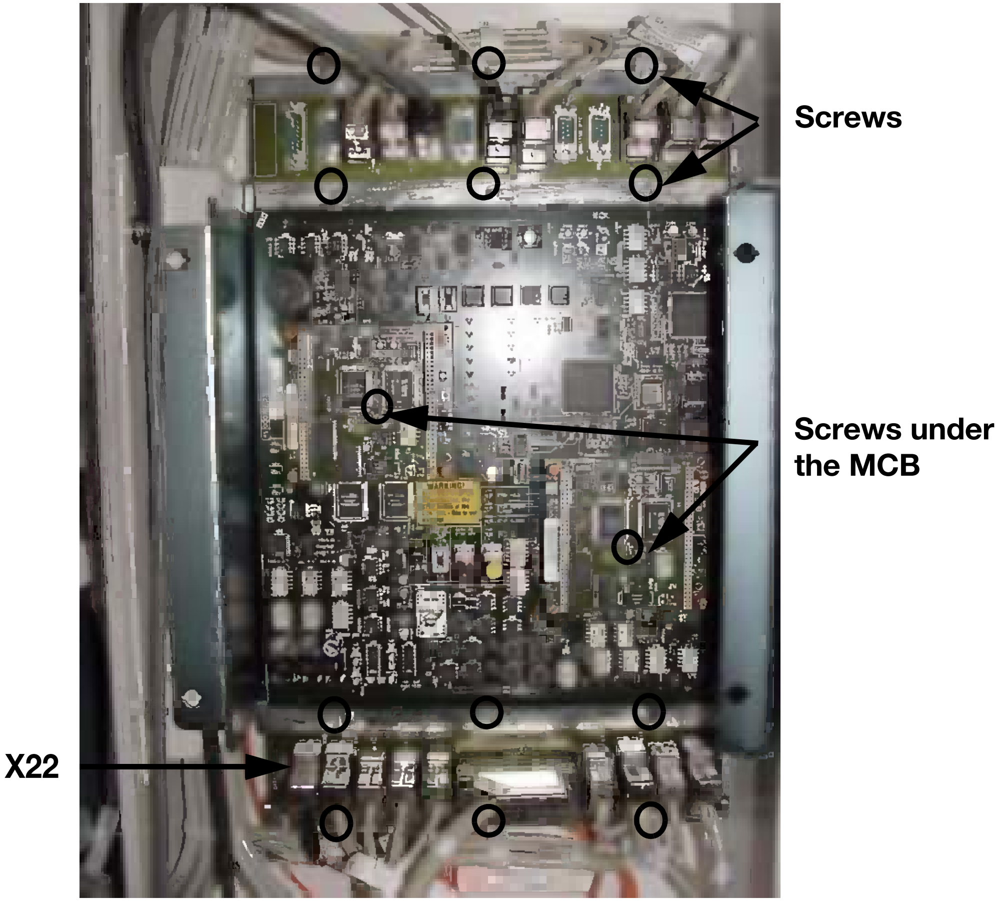


Figure 3-41: Cover of the MCU RTC Board

11. Load the firmware in MCU and RTC if any is replaced. Make sure to install appropriate version of the firmware, according to the software version installed in your workstation.
12. Install the lower and the upper covers of the left side on the Gantry.
13. Turn the Gantry ON from the CT-Box.
14. Perform scans in different modes to ensure that the system is functioning properly.

Replacing the Tilt Spindle

This section describes how to remove the old tilt spindle and install a new one.

Before disconnecting the electrical cables, sketch a diagram of the connections or mark the cables themselves.

Follow all safety precautions when performing the procedure.

Secure the cables with cable ties and/or cable clamps as indicated and ensure that they match their original status.

Required Tools and Auxiliary Materials

To replace the tilt spindle, you need the following:

- Service tool set
- Retaining bolt to prevent the gantry from tilting (M12 x 40)

Preliminary Steps

NOTE:

If the spindle is defective and the Gantry is not in the 0° position, do not force it into the 0° position. The spindle can be replaced when the Gantry is tilted. Use the same procedure in this case.

⚠ **WARNING** ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

1. Remove the upper and then lower covers from the right side of the Gantry.
2. Remove the mechanical lock from the height adjustment mechanism (see *Figure 3-42*).
3. Turn the height adjustment nut (shown in *Figure 3-42*) until the retaining bolt can be inserted (see *Figure 3-42*) into either the upper or lower hole, whichever is aligned first.

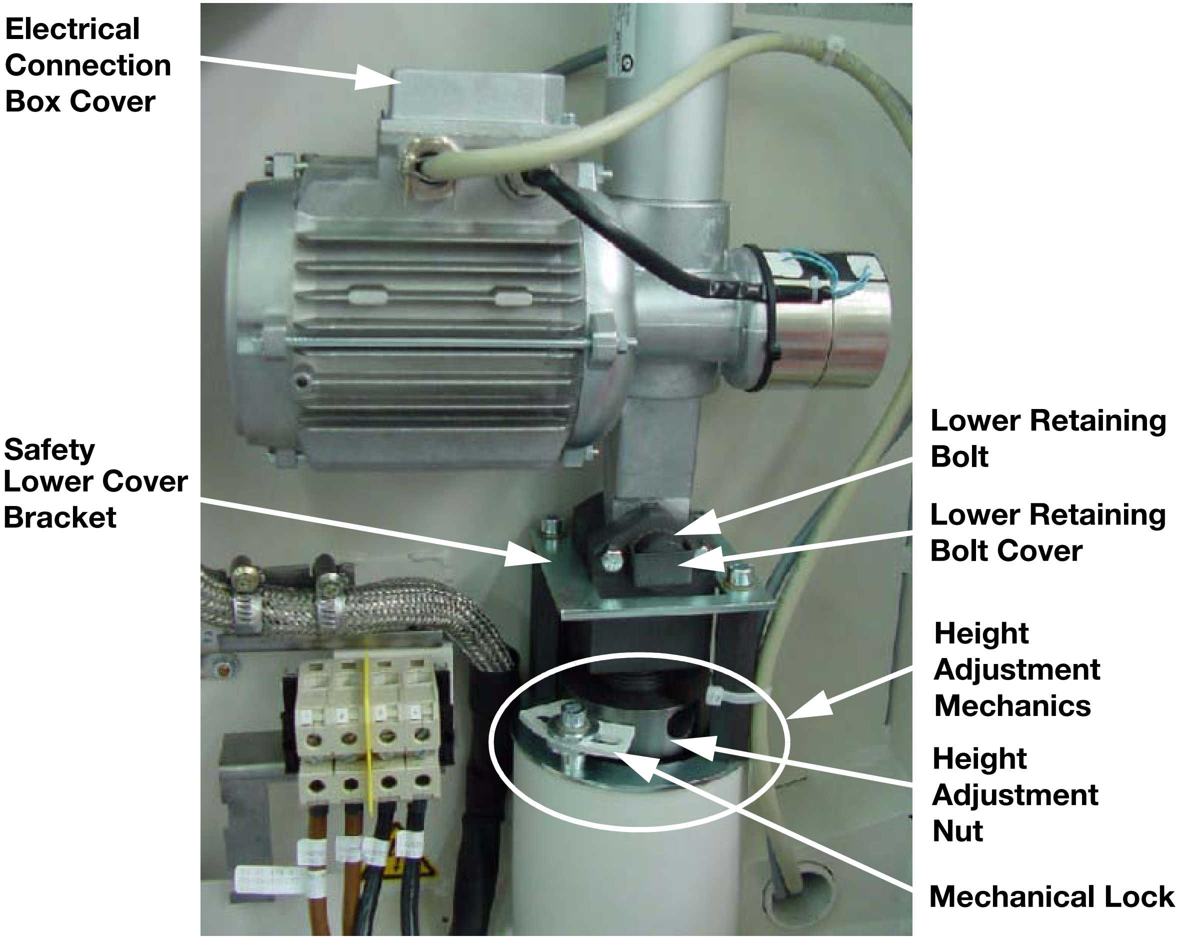

Electrical Connection Box Cover
Safety Lower Cover Bracket
Lower Retaining Bolt
Lower Retaining Bolt Cover
Height Adjustment Mechanics
Height Adjustment Nut
Mechanical Lock

Figure 3-42: Tilt Motor

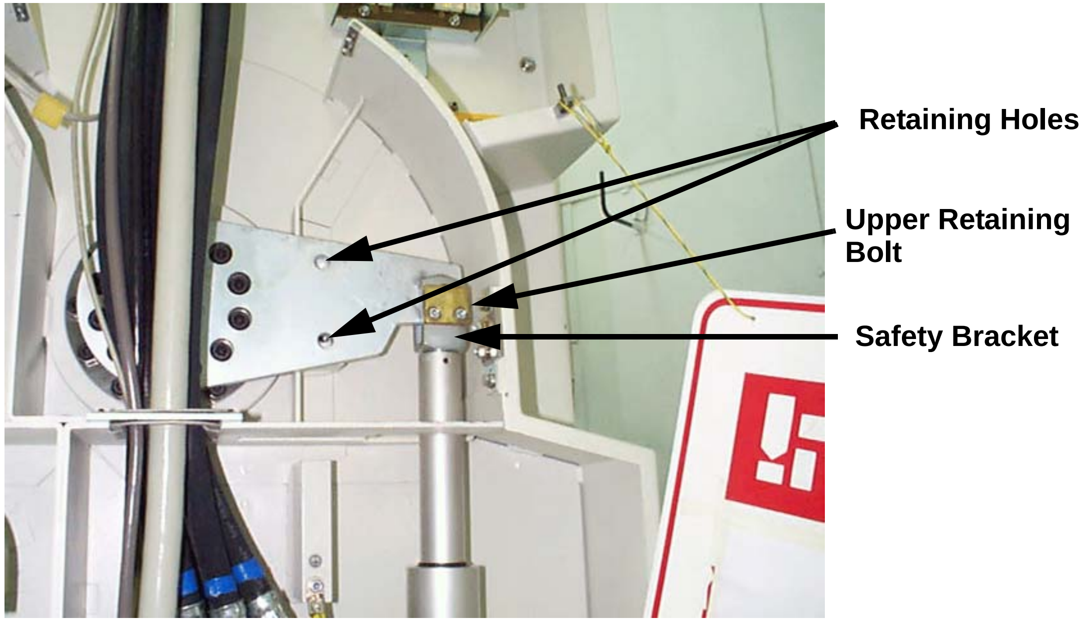


Figure 3-43: Tilt Arm

Removing the Tilt Spindle

Remove the tilt spindle as follows:

1. Remove the cover for the electrical connections (see *Figure 3-42*) and remove the cables.
2. Remove the safety bracket (see *Figure 3-43*) for the upper retaining bolt.
3. Remove two bolts and remove the safety bracket (see *Figure 3-43*) for the lower retaining bolt.
4. Turn the height adjustment nut (see *Figure 3-42*) until you can remove both retaining bolts (see *Figure 3-42* and *Figure 3-42*).
5. Remove the defective tilt spindle.

Installing the Tilt Spindle

Install the tilt spindle as follows:

1. Turn the spindle of the new tilt motor until it corresponds to the length of the defective spindle.

> **NOTE:**
>
> If the length of the replacement spindle is identical to that of the defective one, no tilt adjustment is necessary. If not, the tilt motor may not be able to achieve a ±30° Gantry tilt.

2. Insert the tilt spindle.
3. Insert the upper retaining bolt using a little bit of grease.
4. Attach the safety bracket (*Figure 3-43*) for the upper retaining bolt.
5. Insert the lower retaining bolt (*Figure 3-43*) using a little bit of grease.

> **NOTE:**
>
> If it is not possible to insert the retaining bolt, slightly turn the height adjustment nut (*Figure 3-42*) until it fits.

6. Attach the safety bracket (*Figure 3-43*) for the lower retaining bolt.

> ⚠ **CAUTION**
>
> MAKE SURE TO PULL THE RETAINING BOLT THAT PREVENTS THE GANTRY FROM TILTING DURING SERVICE.

Cable Connections

New Type Spindle

If the tilt spindle that you have removed is the new type as shown in *Figure 3-42* proceed as follows:

1. Route the cables as shown in *Figure 3-42*.
2. Connect the cables to the terminal block as shown in *Table 3-18*.

Table 3-18: Terminal Block Connections

TERMINAL BLOCK	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
WHERE USED	U	V	W	Temp	Temp	Brake 1	Brake 1	Brake 2	Brake 2
	Power Cable			Control Cable and Brake Cable					

3. Check the electrical connections and make sure that they are secure.
4. Attach the electrical connection box cover.

Old Type Spindle

If the tilt spindle that you have removed is the old type (*Figure 3-44*) proceed as follows:

1. Remove the terminal crimps from the cables.
2. Strip approximately 1 cm of insulation from the end of the cable.
3. Route the cables as shown in *Figure 3-42*.
4. Connect the cables to the terminal block as shown in *Table 3-19*.

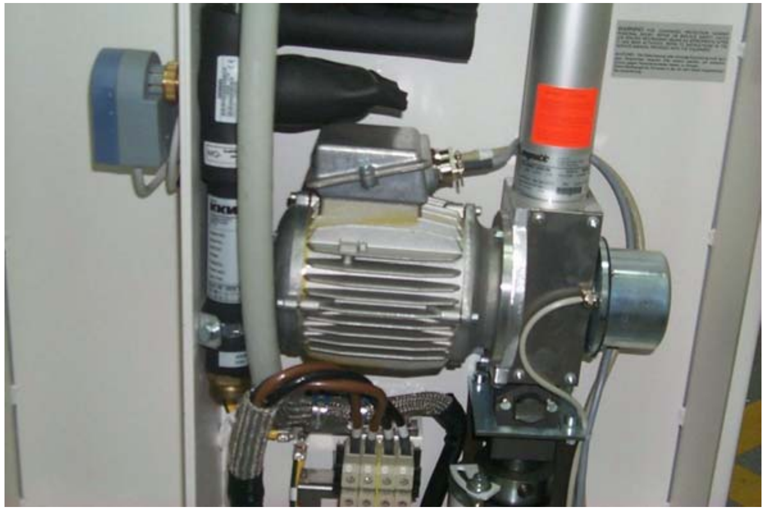


Figure 3-44: Old Type Tilt Spindle

Table 3-19:

CABLE CONNECTIONS CHECK THE LABELS	**2**	**3**	**1**	**5**	**7**	**9**	**6**	**Y2+**	**Y2-**
COLOR OF WIRE	bl3	bl2	bl1	Yellow	Green	Brown	White	Brown	Blue
TERMINAL BLOCK ON NEW MOTOR	1	2	3	4	5	6	7	8	9
WHERE USED	U	V	W	Temp	Temp	Brake 1	Brake 1	Brake 2	Brake 2
	Power Cable			Control Cable and Brake Cable					

5. Check the electrical connections and make sure that they are secure.
6. Attach the electrical connection box cover.
7. Turn the Gantry ON from the CT-Box.

8. Modify the T2A table in the host computer as follows:
    a. Turn the host computer ON and wait for the computer to boot up.
    b. Click on the **Mx8000** icon.
    c. From **Service** in the main menu, enter **MCU Utilities | Edit Tables | Update Tables**.
    d. Select T2A table and click **OK**.
    e. Change the underlined and bold fields as shown below:

```
send 0x00 T 0x2A 0x03 0x60 0x14 0x00 0x01 0x00
send 0x00 T 0x2A 0x64 0x09 0x88 0x07 0xF8 0x01
send 0x00 T 0x2A 0x8C 0x8C 0x28 0x64 0x64 0x02
send 0x00 T 0x2A 0x08 0x08 0x52 0xdC 0x14 0x03
send 0x00 T 0x2A 0x3c 0x03 0x0f 0x14 0x00 0x04
send 0x00 T 0x2A 0x00 0x64 0x00 0x00 0x00 0x05
send 0x00 T 0x2A 0x07 0x07 0x02 0x4B 0x17 0xFF
```

    f. Click **Update** and **Exit**.
9. Logout and then login for the changes to take effect.

Test and Adjustments

1. Turn the Gantry ON from the CT-Box.
2. Test the tilting function of the Gantry using the operating panels. If it is not possible to tilt the Gantry ±30°, use the height adjustment mechanism for adjustment (see *Figure 3-42*).

NOTE:

Attach the mechanical lock to the height adjustment mechanism after completing adjustment.

Final Steps

Install the lower and the upper covers of the right side on the Gantry.

Replacing the Three-Way Valve

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to replace the three-way valve.

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the three-way valve as follows:

1. Remove the upper and then lower covers on the right side of the Gantry.
2. Disconnect the power cable.
3. Turn the nut left to loosen it, and remove the valve as indicated in *Figure 3-2*.
4. Install the new three-way valve in reverse order.
5. Install the lower and then upper covers of the right side of the Gantry.
6. Turn the Gantry ON from the CT-Box and check if the cooling system functions properly.

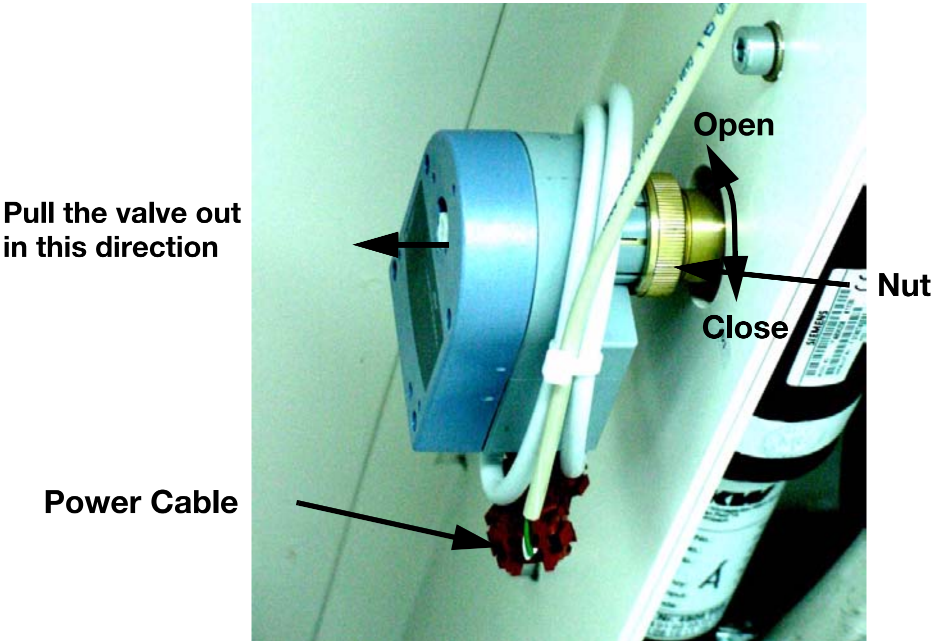


Figure 3-45: The Three-Way Valve

Replacing the GPC Board (D311)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to replace the GPC board.

Follow C-MOS guidelines, all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the GPC board as follows:

1. Remove the upper cover of the right side of the Gantry.
2. Remove the metal cover of the GPC board.
3. Disconnect connectors X1-X9 from the board.
4. Remove the screws indicated in *Figure 3-46*.
5. Remove the old GPC board.
6. Transfer the MCB D2 board from the old GPC board to the new one.
7. Insert the new GPC board and secure it in place with the screws you removed earlier (shown in *Figure 3-46*).
8. Reconnect connectors X1-X9 to the new GPC board. Check that all connections are secure.
9. Put the cover of the GPC board back in place.
10. Load the firmware for MCB D2 in case it is replaced.
11. Turn the Gantry ON from the CT-Box.
12. Test the individual functions of the GPC board.
13. Put the upper cover of the right side of the Gantry back in place.
14. Test all possible tilt and feed functions, including the light marker on both key panels.

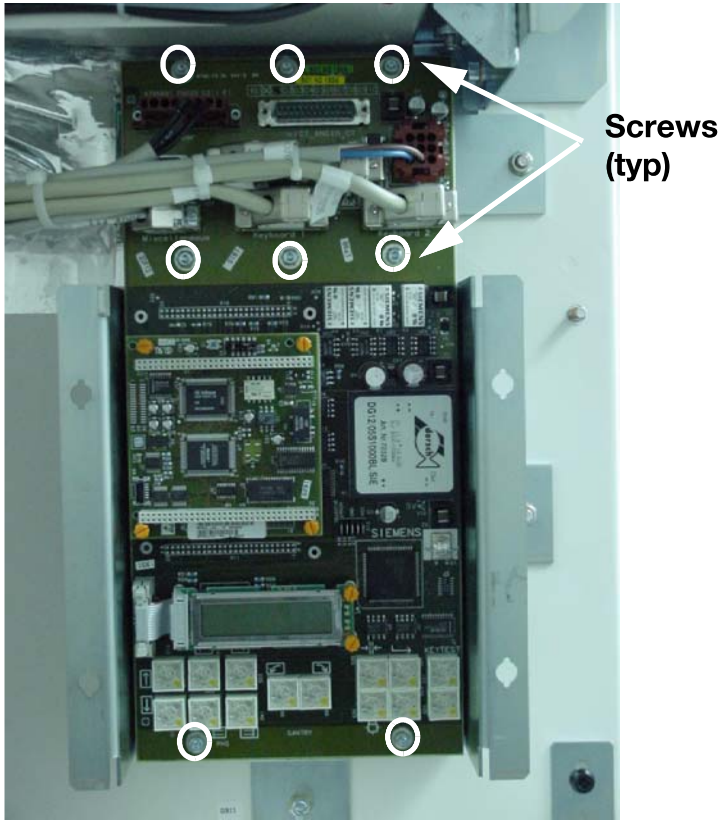


Figure 3-46: GPC Board

Replacing the Dehumidifier

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need insulation tape and a standard service kit to replace the dehumidifier.

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the dehumidifier as follows:

1. Remove the upper cover of the right side of the Gantry.
2. Disconnect the connectors E321 (X1, X2).
3. Remove all cable ties that interfere with the cables.
4. Remove the screws indicated in *Figure 3-3*.Carefully remove the air flow insulation tape indicated in *Figure 3-3*.
5. Remove the dehumidifier.
6. Install the new humidifier.
7. Replace the screws shown in *Figure 3-3* that you removed earlier and tighten them with a torque of 5 Nm.
8. Apply insulation tape.

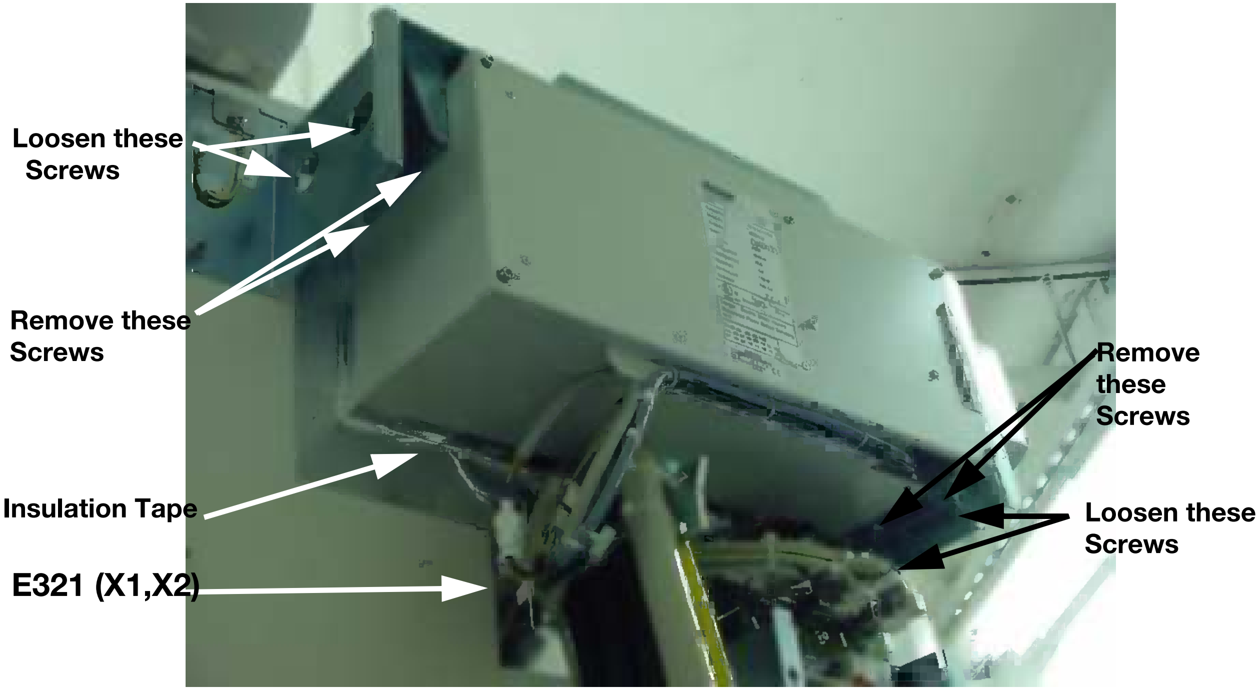

Loosen these Screws
Remove these Screws
Insulation Tape
E321 (X1,X2)
Remove these Screws
Loosen these Screws

Figure 3-47: The Humidifier

9. Turn the Gantry ON from the CT-Box.
10. Cover any points through which air escapes from the rotating part of the Gantry with insulating tape.
11. Put the upper cover of the Gantry back in place.

Replacing the Noise Cancellation Board (D344)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to replace the Noise Cancellation board.

Follow C-MOS guidelines, all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the noise cancellation board as follows:

1. Loosen two screws on the lower part of the Gantry rear cover and remove it.
2. Disconnect connectors X1, X3, and X4 from the board as shown in *Figure 3-48*.
3. Loosen four screws and remove the board.
4. Replace the board and install it in reverse order.
5. Install the Gantry rear cover and tighten the two screws.
6. Turn the switch F1, located in the PDC, ON. Turn the Gantry and the workstation ON.
7. Make sure that the intercom functions properly.

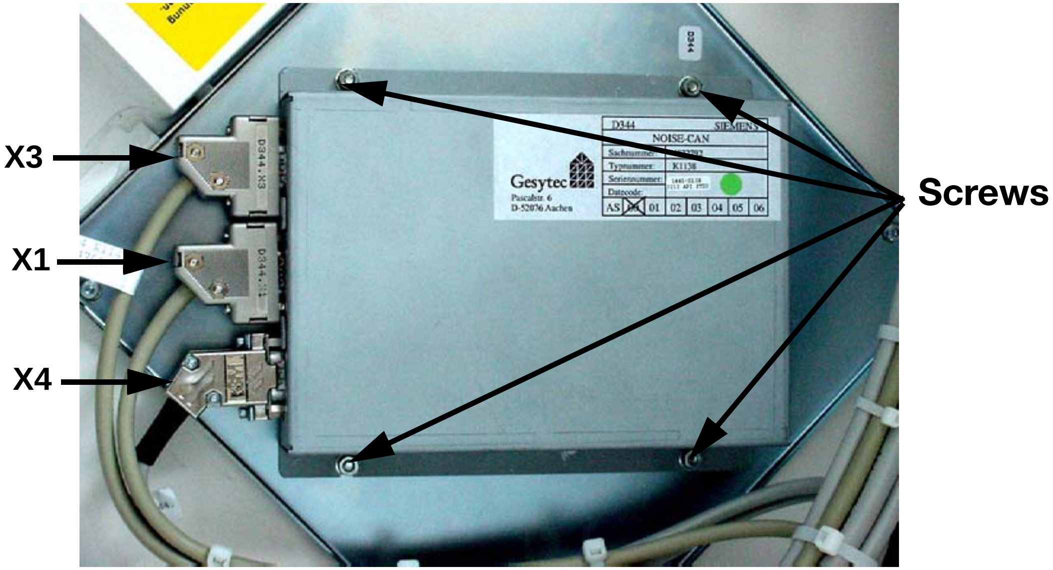


Figure 3-48: The Noise Cancellation Board (D344)

Replacing the Brake Assembly (E322)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to replace the brake assembly.

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, PERFORM LOGOUT AND SHUTDOWN OF THE HOST COMPUTER. TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the brake assembly as follows:

1. Loosen two screws on the lower part of the Gantry rear cover and remove it.
2. Disconnect connectors X2, X3, cables X322 PE and W318, and remove two tie wraps.
3. Remove the brake assembly as indicated in *Figure 3-49*.
4. Install the new brake assembly in reverse order.
5. Install the Gantry rear cover and tighten two screws to its lower part.
6. Turn the switch F1, located in the PDC, ON. Turn the Gantry and the workstation ON.
7. Make sure that the system functions properly in all rotating modes.

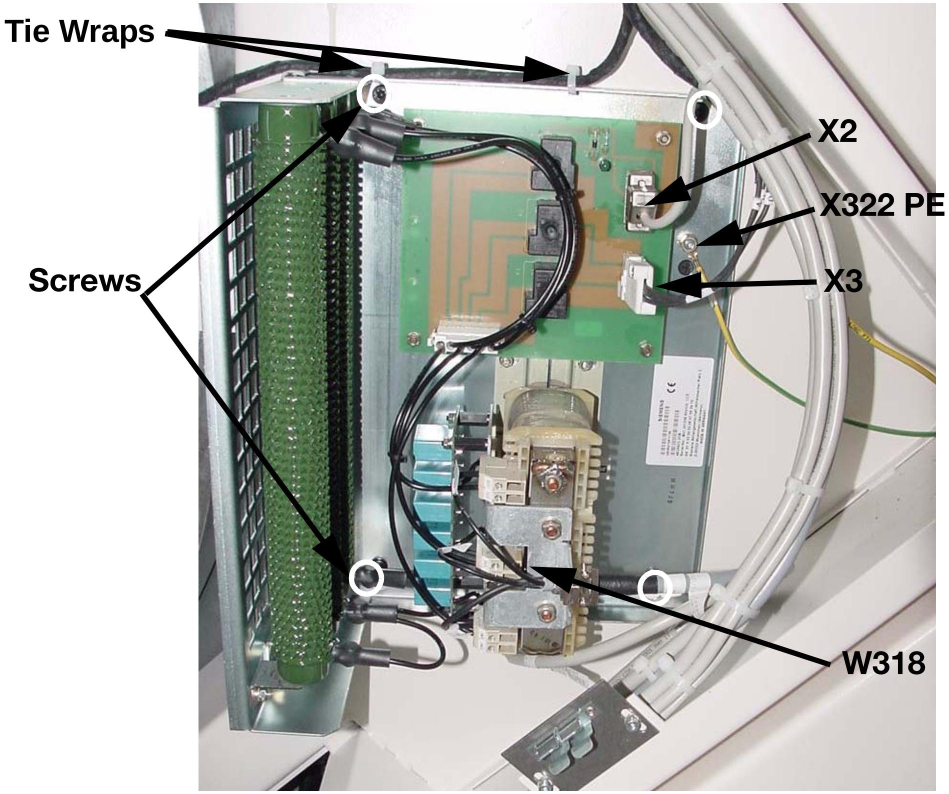


Figure 3-49: The Brake Assembly (E322)

Replacing the Transmitter and Receiver Boards

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to replace the transmitter and receiver boards.

Follow C-MOS guidelines, all general safety guidelines and radiation protection ordinances (see *"Safety Guidelines"*).

NOTE:

Transmitter and receiver boards are shipped together. Whenever it is necessary to replace one of them, replace both.

WARNING

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, PERFORM LOGOUT AND SHUTDOWN OF THE HOST COMPUTER, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the transmitter and receiver boards as follows:

1. Loosen two screws on the lower part of the Gantry rear cover and remove it.
2. Remove the funnel according to the procedure described in *"Removal and Installation of the Funnel"*.
3. Disconnect E400 - X1 and E400 - X2, remove two screws and receiver board (see *Figure 3-50*).

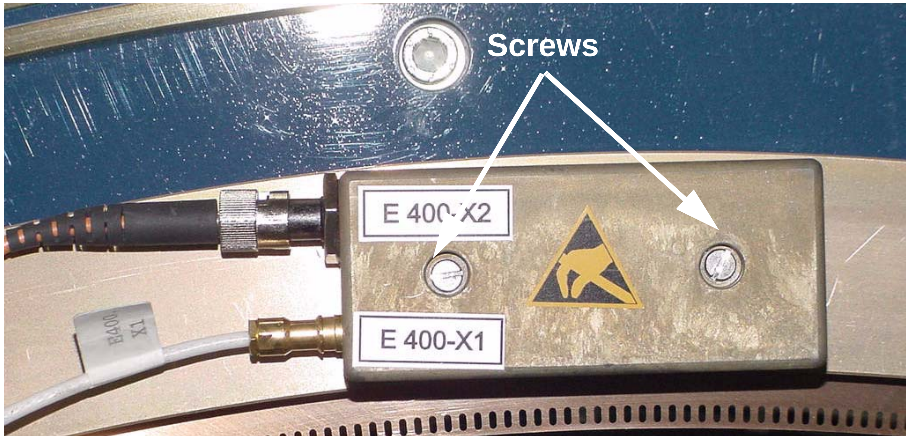


Figure 3-50: The Receiver Board

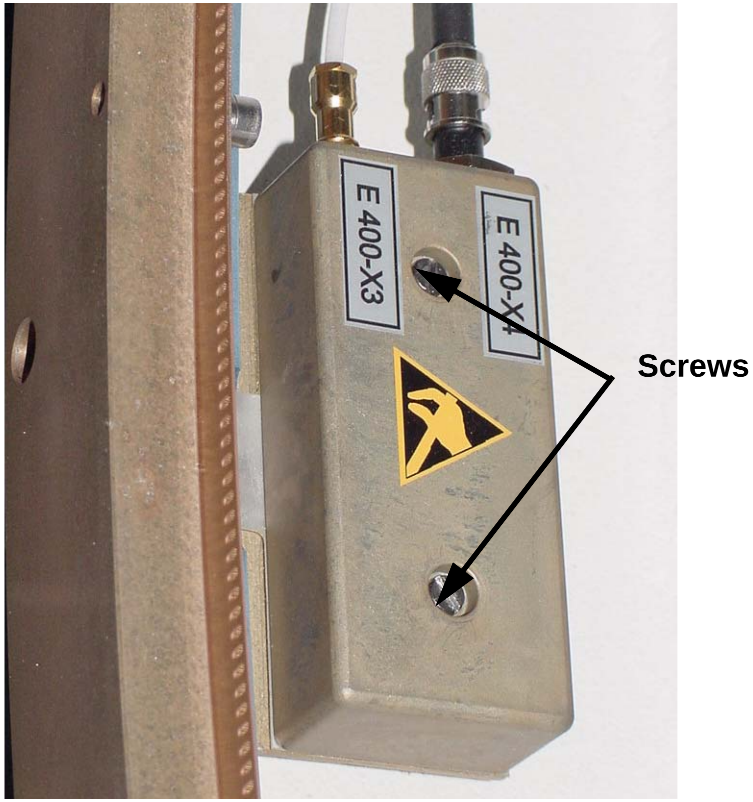


Figure 3-51: The Transmitter Board

Replace the transmitter and receiver boards as follows:

1. Loosen two screws on the lower part of the Gantry rear cover and remove it.
2. Remove the funnel according to the procedure described in *“Removal and Installation of the Funnel”*.
3. Disconnect E400 - X1 and E400 - X2, remove two screws and receiver board (see *Figure 3-50*).
4. Disconnect E400 - X3 and E400 - X4. Remove two screws and transmitter board (see *Figure 3-51*).
5. Install the new transmitter and receiver boards in reverse order.
6. Install the funnel according to the procedure described in *“Removal and Installation of the Funnel”*.
7. Install the Gantry rear cover and tighten two screws to its lower part.
8. There is no adjustment needed after replacing these boards.
9. Turn the switch F1, located in the PDC, ON. Turn the Gantry and the workstation ON.
10. Perform some Helix scans to make sure that the system functions properly.

Replacing the Gantry Heat Exchanger

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need a M32 crescent wrench and an adjustable wench, in addition to a standard service kit to replace the gantry heat exchanger.

Follow all general safety guidelines and radiation protection ordinances (*"Safety Guidelines"*).

WARNING

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, PERFORM LOGOUT AND SHUTDOWN OF THE HOST COMPUTER, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the gantry heat exchanger as follows:

1. Move the Couch to Max out and Max Down.
2. Loosen the two screws on the Gantry front cover and open the front cover.
3. Drain the system
4. Remove the cap nuts indicated in *Figure 3-52* from the cooling hoses.
   Use the adjustable wrench to hold the hexagonal nut on the heat exchanger.
5. Remove the four regular nuts (two are indicated in *Figure 3-52*) from the heat exchanger.
6. Install the new heat exchanger and replace the cap nuts and regular nuts in their original position. Tighten them to a torque of 40 Nm.
7. Check the hose connections and ensure that they are completely sealed.
8. Refill the cooling system.
9. Turn the Gantry ON from the CT-Box and the main power switch.
10. Check that the cooling system is working properly.
11. Close the Gantry front cover, and tighten the two screws in the lower part of the Gantry front cover.

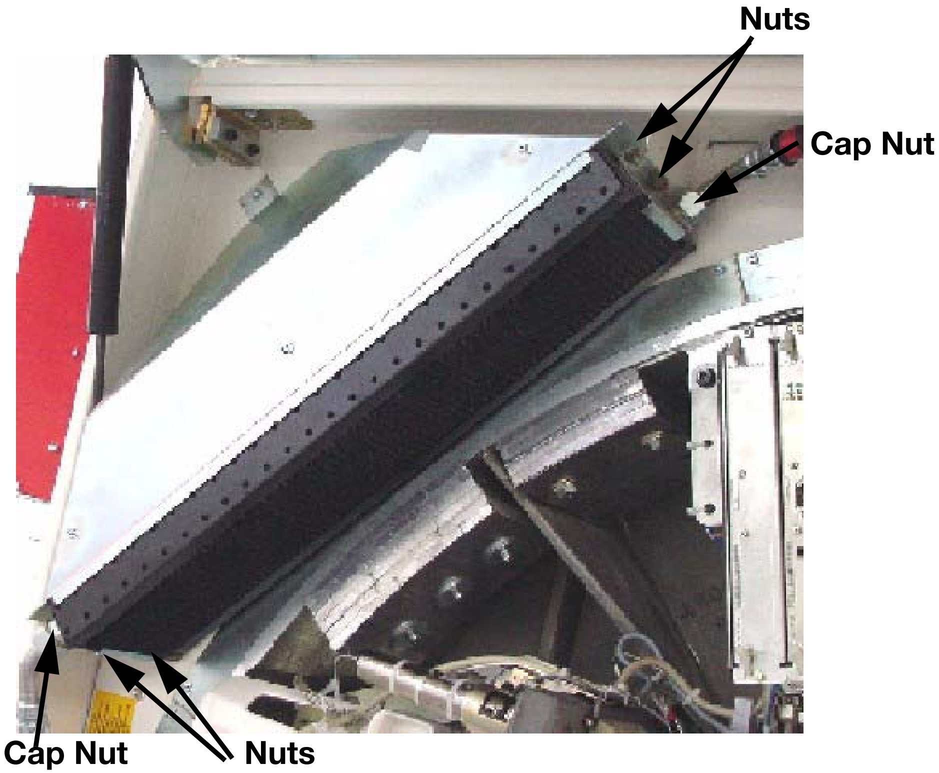


Figure 3-52: Heat Exchanger and Fan Front Cover

Replacing the Fan

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You only need a standard service kit to replace the fan.

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

WARNING

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, PERFORM LOGOUT AND SHUTDOWN OF THE HOST COMPUTER, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Replace the fan as follows:

1. Move the Couch to Max out and Max Down.
2. Loosen the two screws on the Gantry front cover, remove the Plexiglas ring and open the front cover.
3. Loosen two screws on the lower part of the Gantry rear cover and remove it.
4. Remove the front fan cover by removing the screws shown in *Figure 3-53*.
5. Disconnect the appropriate M304-M306 cable shown in *Figure 3-54*.
6. Remove the back fan cover by removing the screws shown in *Figure 3-54*.

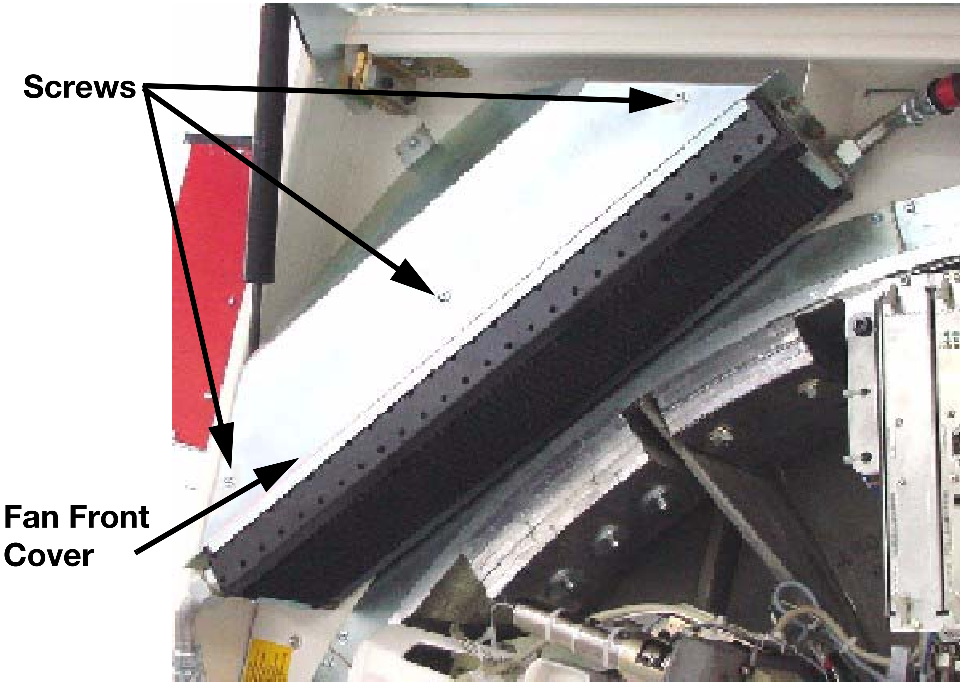


Figure 3-53: Fan

7. Remove the old fan through the opening in the back.
8. Install the new fan and connect the appropriate cable (M304-M306).
9. Install the Gantry back cover and tighten two screws to its lower part.
10. Turn the switch F1, located in the PDC, ON. Turn the Gantry and the workstation ON.
11. Check that the fan and heat exchanger are functioning properly.
12. Close the Gantry front cover, install the Plexiglas ring, and tighten the two screws in the lower part of the Gantry front cover.

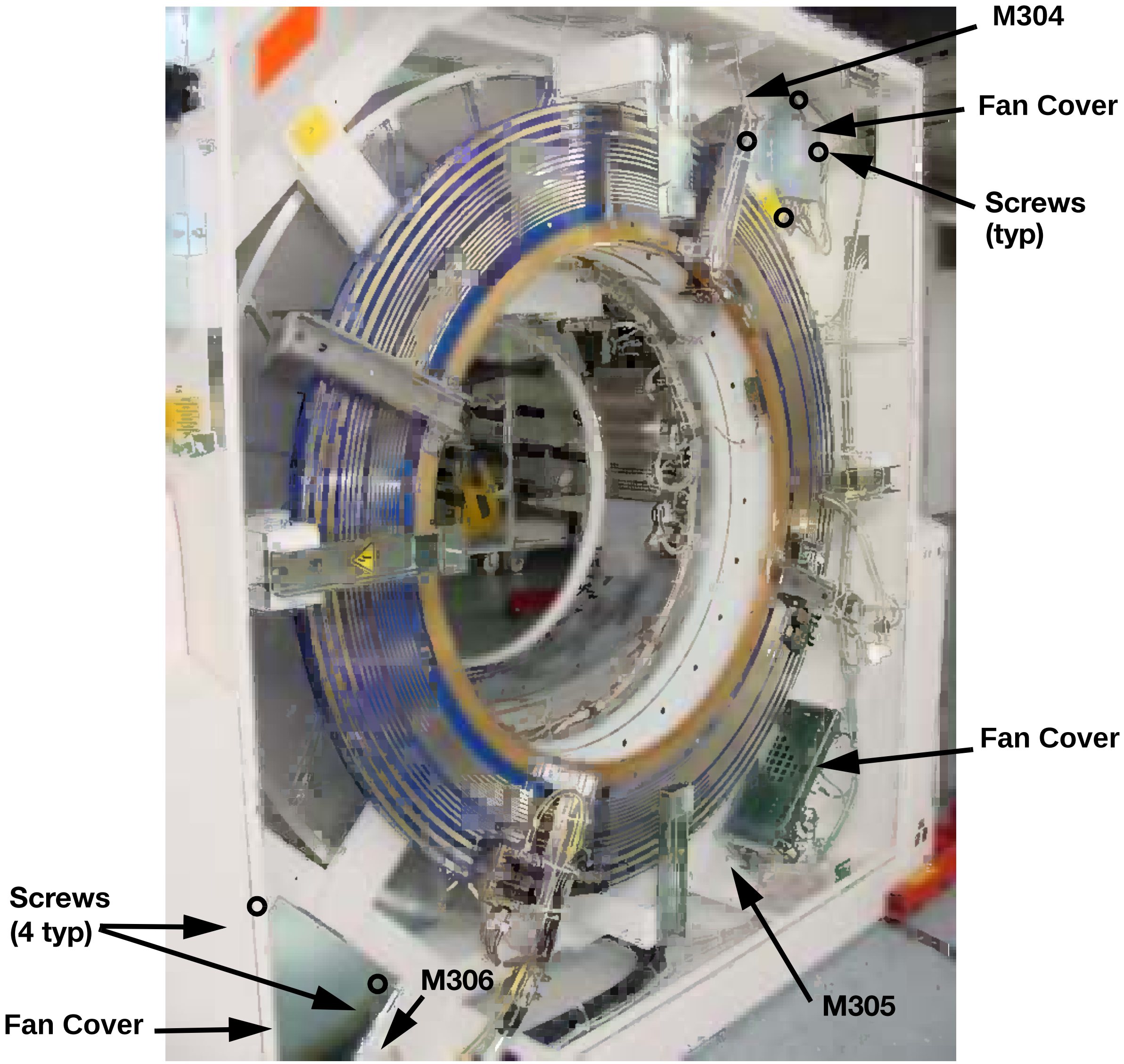


Figure 3-54: Back Fan Covers

Removal and Installation of the Funnel

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You need only a standard service kit to remove and install the funnel.

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE YOU PERFORM ANY WORK, PERFORM LOGOUT AND SHUTDOWN OF THE HOST COMPUTER, TURN THE GANTRY OFF FROM THE CT-BOX AND FROM THE MAIN POWER SWITCH.

Remove the funnel as follows:

1. Move the Couch to Max out and Max Down.
2. Loosen the two screws on the Gantry front cover and open the front cover.
3. Loosen two screws on the lower part of the Gantry rear cover and remove it.

4. Disconnect the plugs X312 and X325 located on the funnel (see *Figure 3-55*).
5. Loosen four screws and remove funnel. Two of the four screws are shown in *Figure 3-55*. The other two screws are located on the angle 180 degrees from each other.

CAUTION

BE CAREFUL! WHEN REMOVING AND INSTALLING THE FUNNEL BE CAREFUL NOT TO DAMAGE THE SLOT RING.

6. Install the funnel in reverse order.
7. Tighten four screws and plugs X312 and X325.
8. Turn the rotor by hand to ensure its unobstructed rotation.
9. Install the Gantry back cover and tighten two screws to its lower part.
10. Close the Gantry front cover, install the Plexiglas ring, and tighten the two screws in the lower part of the Gantry front cover.
11. Turn the switch F1, located in the PDC, ON. Turn the Gantry and the workstation ON. Turn switch S301 ON.
12. Make sure that the intercom functions properly.

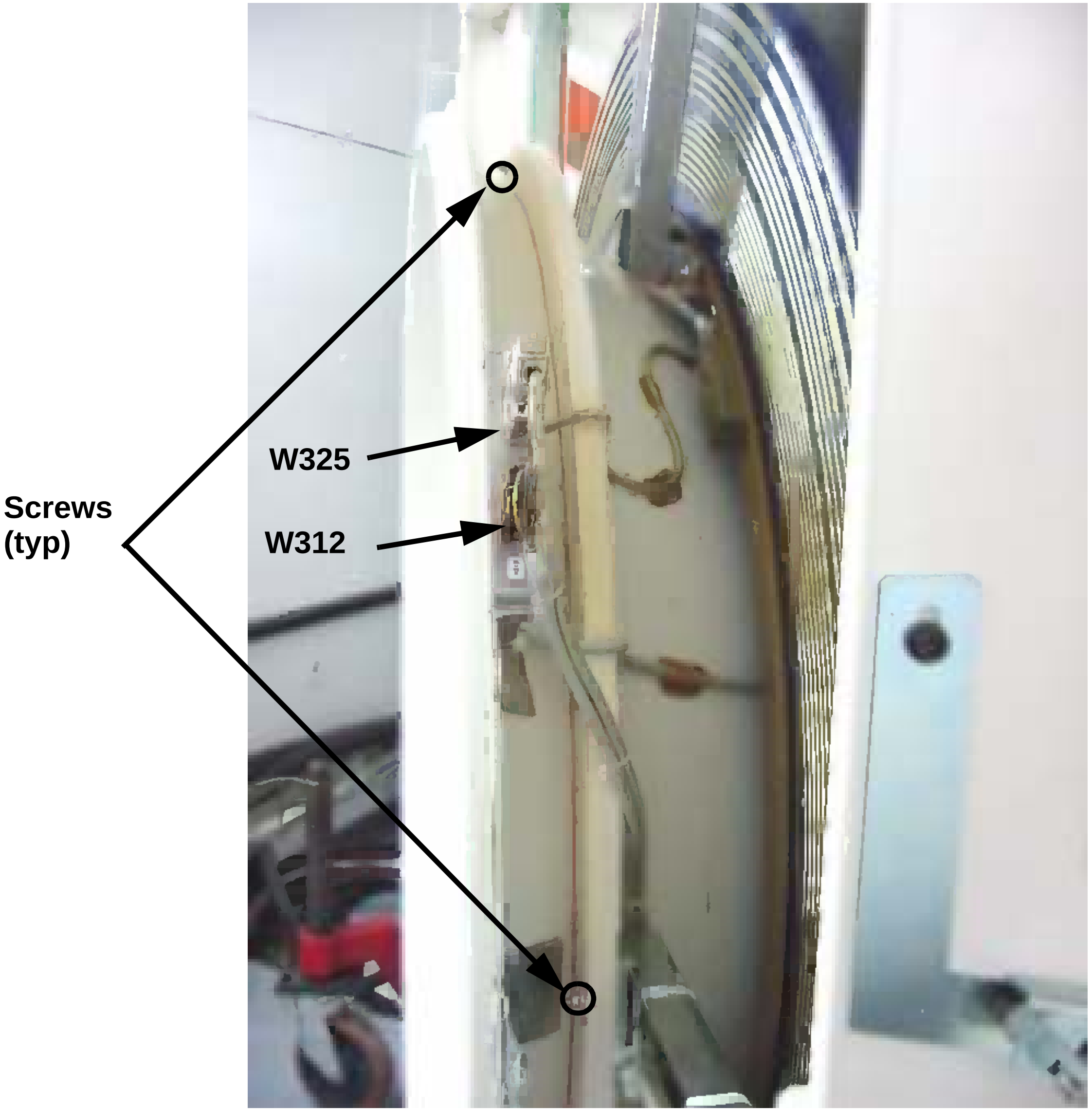


Figure 3-55: The Funnel

Replacement and Adjustment of the Stator Laser Light Markers

The purpose of this section is to provide the FSE with the following instructions concerning the stator laser light marker:

- Marker removal
- Installation of the new marker
- Test and adjustment of the new marker

You need only a standard service kit to replace and adjust the stator light markers.

Use these procedures in case of failure in the original light marker or if adjustments are needed for any reason.

Removal of the Laser Light Marker

There are four laser light markers on the rotor.

1. Disconnect the connectors from the light marker (*Figure 3-56*).
2. Loosen the two screws and remove the complete light marker assembly with the mounting bracket.

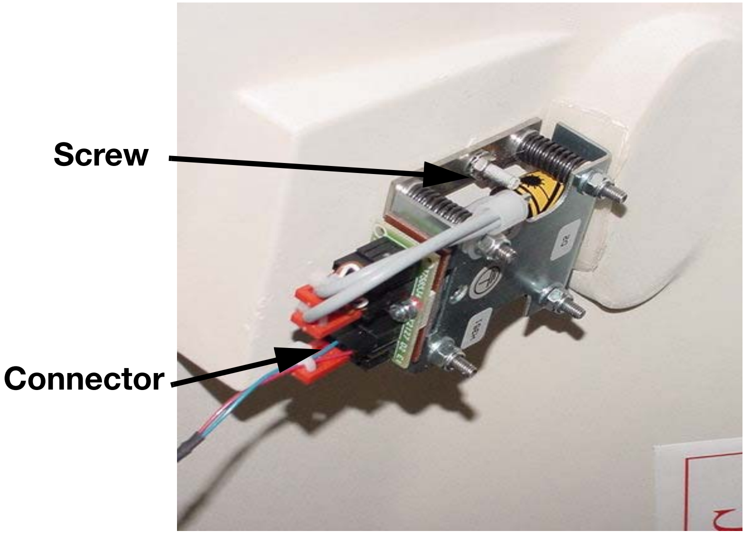


Figure 3-56: Laser Light Marker

Installing the New Laser Light Marker

1. Attach the new laser light marker with the two screws and tighten them to a torque of 6 Nm.
2. Attach the appropriate connectors.

Tests and Adjustments

1. Close the Gantry front cover and tighten the two screws.
2. Turn the Gantry ON.
3. Turn the light marker ON from the gantry panel.
4. Position the system phantom in the middle of the scan circle (couch height approximately 125mm) so that the light falls on one of the notches on the phantom (*Figure 3-57*).

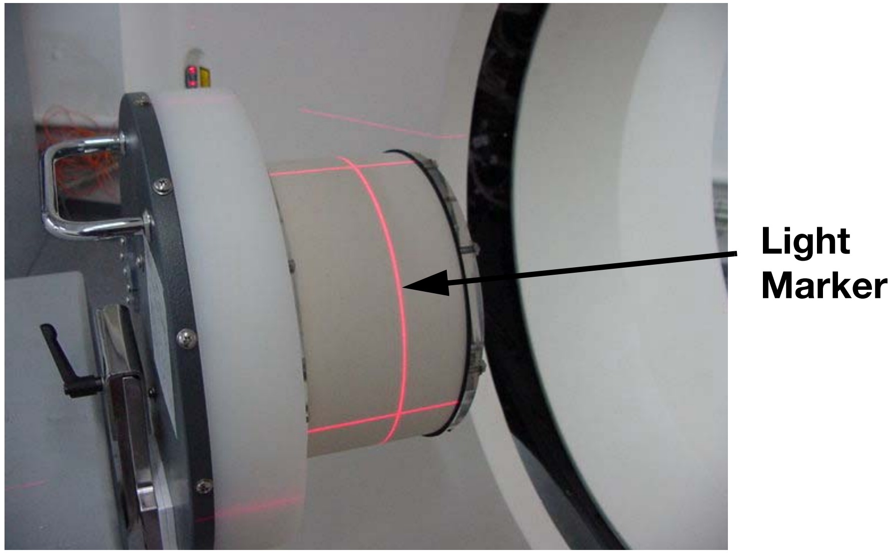


Figure 3-57: Light Markers on System Phantom

Verify a continuous line on the system phantom. If the line is duplicate, adjust the light marker as follows:

1. Cover one of the light markers to find out which one needs calibration.
2. Open the Gantry front cover and adjust as follows (see *Figure 3-58*):
   a. If the line is duplicate, adjust it with screws A and B (*Figure 3-59*).
   b. If the line is duplicate, adjust it with screw C (*Figure 3-59*).

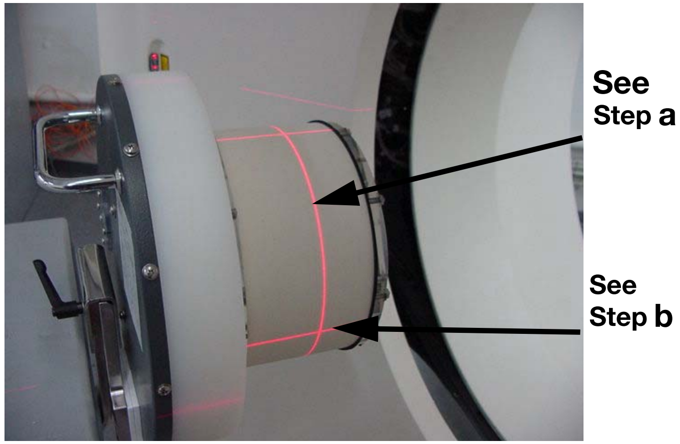


Figure 3-58: System Phantom

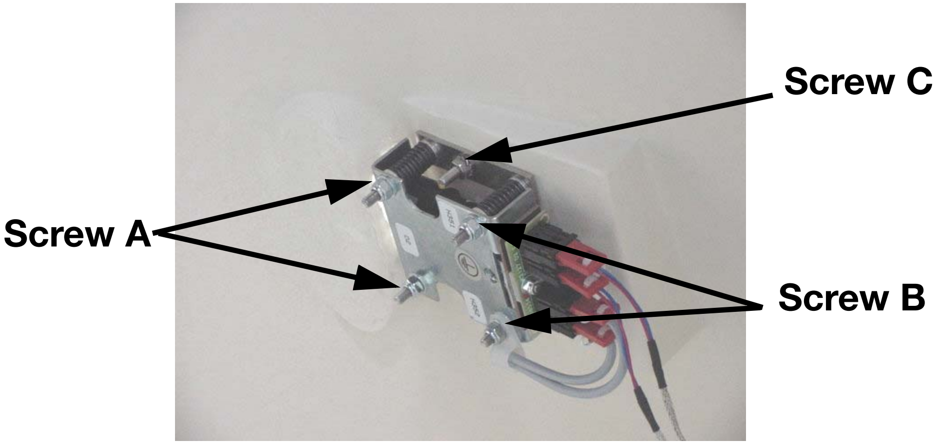


Figure 3-59: Light Marker Adjustment Screws

Final Steps

1. Turn the service switch S-301 to 1.
2. Close the Gantry door and carefully insert the mylar gasket.
3. Turn the light markers ON. Verify that the light markers line up on the system phantom.

Gantry Rotating Overview

Components

The block diagram in *Figure 3-60* shows the functional groups of the Gantry Rotating and their external signal flow with other components. The Internal Signal Flow is shown with its communication paths.

DELPHI The Detector Collimator, Light marker and Phi-Control Board (DELPHI) is a multifunction board that performs the following tasks:

Table 3-20:

TASK	DESCRIPTION
Detector Collimation	The collimator aperture depends on the selected slice thickness.
Light Marker	The Light Markers that indicate the actual scan slice location are controlled by the DELPHI.
Focus Deflection	The focus position is regulated during a scan.
Tube Monitoring	Oil temperature and pressure are monitored.

Z_CON The Z-Control Board (Z-CON) is a multifunction board that performs the following tasks:

Table 3-21:

TASK	DESCRIPTION
Tube Collimation	Position the A-Plane Collimator prior to a scan, according to the selected slice thickness.
Z-Control	Position the A-Plane Collimator according to the focal spot movement during a scan, to keep the fan beam above the detector center.
UHR Collimation	Move the Ultra High Resolution (UHR) Collimator into the X-ray beam on top of the detector.
Air Scan Compensator	Move the Compensator into the X-ray beam inside the Tube Collimator Box.

ACU The Acquisition Control Unit (ACU) is the interface between the DMS, the Gantry Rotating and the Gantry Stationary. It is also responsible for the scan coordination.

Power Supply - DPU1 and DPU2

Two Digital Power Units (DPU1 and DPU2) supply the Gantry Rotating and the DMS (Data Measuring System) with the appropriate DC power.

DOM The task of the Dose Modulation (DOM) Board is to modulate the dose signal with a control signal. The modulated dose signal adapts the X-ray dose to minimize the average applied X-ray.

TUS The Tube System (TUS) contains the Dura Akron B X-ray tube, with focus deflection coil and tube monitoring sensors.

TUC The Tube Collimator (TUC) Box includes: Phi_monitor, Z_monitor, air scan compensator wedge and A-Plane Collimator.

DEC The Detector Collimator (DEC) assembly includes the Detector Collimator and the Ultra High Resolution (UHR) Collimator.

Detector Collimator (P-Plane Collimator)

The Detector Collimator is adjusted by a DC-motor (M1) that is controlled by the Microcontroller and Base Hardware Board (MCB) of the DELPHI. The actual position of the P-Plane Collimator is determined by a position encoder (E1) attached to the diaphragm assembly.

Light marker

The Light marker is built of four laser lights.

Tube Collimator (A-Plane Collimator)

A stepping motor (M1, M2) controls each side of the collimator. The actual diaphragm position is determined by two position generators (E1, E2) attached to each one of the stepping motors. The actual fan beam position above the detector is measured by the Z-Monitor located inside the Tube Collimator Box.

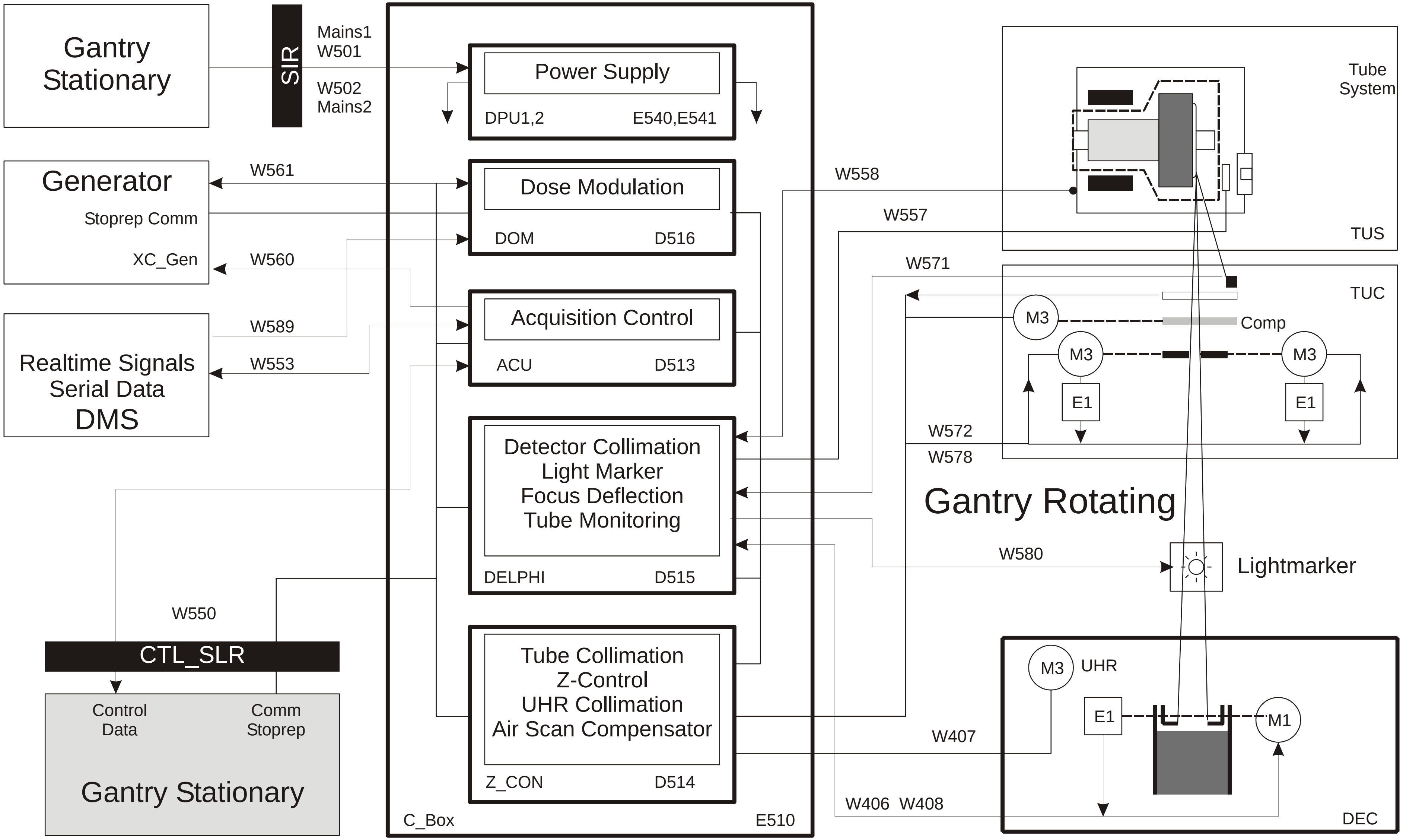

Gantry Stationary
SIR
Mains1
W501
W502
Mains2
Power Supply
DPU1,2
E540,E541
Generator
Stoprep Comm
XC_Gen
W561
W560
Dose Modulation
DOM
D516
Realtime Signals
Serial Data
DMS
W589
W553
Acquisition Control
ACU
D513
Detector Collimation
Light Marker
Focus Deflection
Tube Monitoring
DELPHI
D515
W550
CTL_SLR
Control
Data
Comm
Stoprep
Gantry Stationary
Tube Collimation
Z-Control
UHR Collimation
Air Scan Compensator
Z_CON
D514
C_Box
E510
W558
W557
W571
Tube
System
TUS
TUC
M3
Comp
M3
M3
E1
E1
W572
W578
Gantry Rotating
W580
Lightmarker
M3
UHR
E1
M1
W407
W406 W408
DEC

Figure 3-60: Gantry Rotating Block Diagram

Gantry Rotating Functions

COMM Communication to the external components takes place via the Controller Area Network (CAN) connection. All mode requests and exposure parameters are via this path. The real-time signals are connected via additional signal lines to the different boards.

Stoprep The **Stoprep** loop is connected through the different function controllers and then to the Generator.

Control Data
Data transfer from the stationary to the rotating part of the Gantry and vice versa.

Phi-monitor
The actual focus position comes from the Phi-monitor. The Phi-monitor is the feedback that is used by the DELPHI to regulate the focus position via the deflection coil within the X-ray tube.

Focus Deflection 1

Focus Position Acquisition consists of:

- The Z-monitor that is located inside the collimator box. It is used to pick up the actual focus position in Z-direction.
- Phi_Amp-The current signals from the Z-monitor are converted into a voltage by the amplifier on D555 and the A/D converter. The amplifier is located near the Position Sensitive Device (PSD) because the transmitted current is relatively small.

Figure 3-61 shows the hardware of the focus deflection circuit that consists of the following components:

Table 3-22:

COMPONENT	DESCRIPTION
D515, DELPHI	Hardware regulator, power stage, logic circuit. D554, Phi_Z_Mon-Phi-PSD, Position Sensitive Device, actual focus position acquisition.
D555, PHI_Amp	Actual focus position acquisition, current to voltage amplifier. Phi_coil - Deflection coil, located within the E550, Tube System.

Overview

Phi_Amp The current signals **Phi_PSD1** and **Phi_PSD2** from the D554 Phi_Z_Mon are converted to a voltage by the amplifier on D555. The amplifier is located close to the Phi_Z_Mon since the current is rather small. The gain of the amplifier can be changed by MCB D2 depending on the selected scan parameter. The voltage U1 and U2 are then connected as differential signals **Focmon1** and **Focmon2** to the D414 DELPHI.

U1+U2 The Focmon voltages are added, i.e., **U1+U2=SUM**
Result is the signal SUM that represents the actual radiation intensity at the phi_monitor (Position Sensitive Device, PSD).

U1-U2 The Focmon voltages are subtracted, i.e., **U1-U2 = DIF**
Resulting in the signal DIF that represents the actual focus position above the phi_monitor (PSD).

DIF/SUM **DIF** is divided by **SUM**, i.e., **DIF/SUM=FOCACT**, to compensate close variation. The result is the signal Focact that represents the normalized actual focus position above the phi_monitor (PSD). “Normalized” means the signal is independent of the actual radiation intensity at the phi_monitor.

Foc_Reg A hardware P1_regulator compares **Focact** and **Focref**. Depending on the difference, the **Foc_Reg** outputs a voltage to the power stage.

Power Stage (U/I)

The Power Stage converts the voltage from **Foc_Req** to the deflection current coil output.

Signal Generator

The delay stage output is connected to an Analog Signal Generator that generates an analog voltage used as FOCREF. The shape of the deflection curve is a trapezoid.

Delay Stage

The signal for Even Reading (**Even_rea**) enables the generation of one deflection cycle. It is delayed for fine adjustment of the deflection timing by the value set from the MCB.

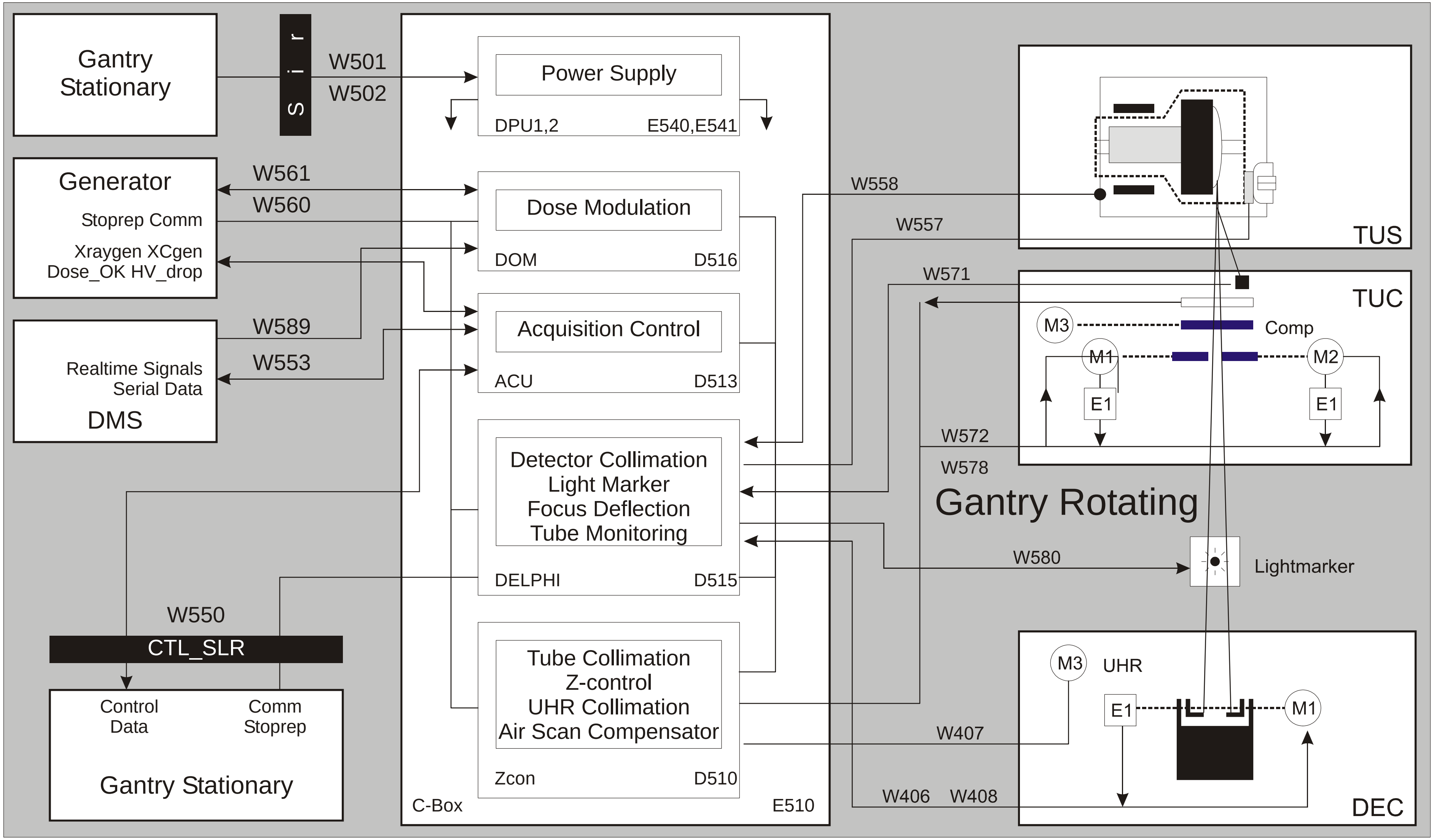

Gantry Stationary
S i r
W501
W502
Power Supply
DPU1,2
E540,E541
Generator
W561
W560
Stoprep Comm
Xraygen XCgen
Dose_OK HV_drop
Dose Modulation
DOM
D516
W589
W553
Realtime Signals
Serial Data
DMS
Acquisition Control
ACU
D513
Detector Collimation
Light Marker
Focus Deflection
Tube Monitoring
DELPHI
D515
W550
CTL_SLR
Control
Data
Comm
Stoprep
Gantry Stationary
Tube Collimation
Z-control
UHR Collimation
Air Scan Compensator
Zcon
D510
C-Box
E510
W558
W557
TUS
W571
TUC
M3
Comp
M1
M2
E1
E1
W572
W578
Gantry Rotating
W580
Lightmarker
M3
UHR
E1
M1
W407
W406
W408
DEC

Figure 3-61: Focus Deflection 1 Block Diagram

LEDs

XRAY	XRAY is lit if the signal SUM (radiation intensity) exceeds the threshold set by Xrayon_ref. It enables the regulator only if radiation is present.
DEFL	DEFL is lit when the MCB enables the focus deflection with the signal Defl_on (Deflection on).

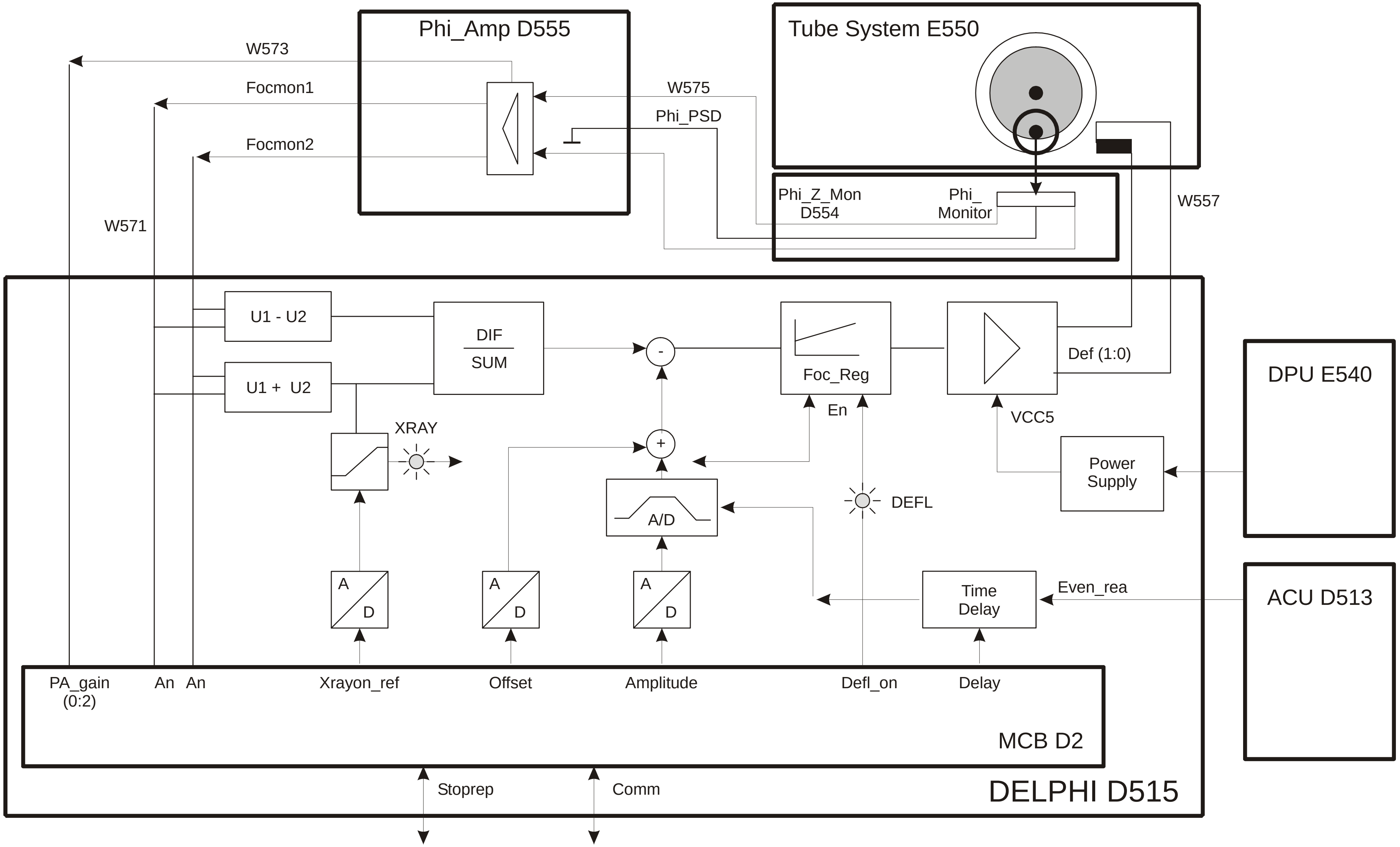

Phi_Amp D555
Tube System E550
W573
Focmon1
Focmon2
W575
Phi_PSD
W571
Phi_Z_Mon
D554
Phi_
Monitor
W557
U1 - U2
U1 + U2
DIF
SUM
-
Foc_Reg
Def (1:0)
DPU E540
En
VCC5
XRAY
+
Power
Supply
A/D
DEFL
A
D
A
D
A
D
Time
Delay
Even_rea
ACU D513
PA_gain
(0:2)
An
An
Xrayon_ref
Offset
Amplitude
Defl_on
Delay
MCB D2
Stoprep
Comm
DELPHI D515

Figure 3-62: Focus Deflection 1 LEDs

Test Points

SUM	SUM represents the actual radiation intensity at the Phi_Monitor (Position Sensitive Device, PSD).
DIF	DIF represents the actual focus position above the Phi_Monitor (PSD).
FOCACT	Focus Actual (FOCACT) represents the normalized actual focus position above the Phi_Monitor (PSD). “Normalized” means the signal FOCACT is independent of the actual radiation intensity at the Phi_Monitor.
FOCREF	Focus Reference (FOCREF) is the nominal focus position. The signal generator output is modified by amplitude and offset.
DEV	Deviation (DEV) is between actual and nominal focus position.

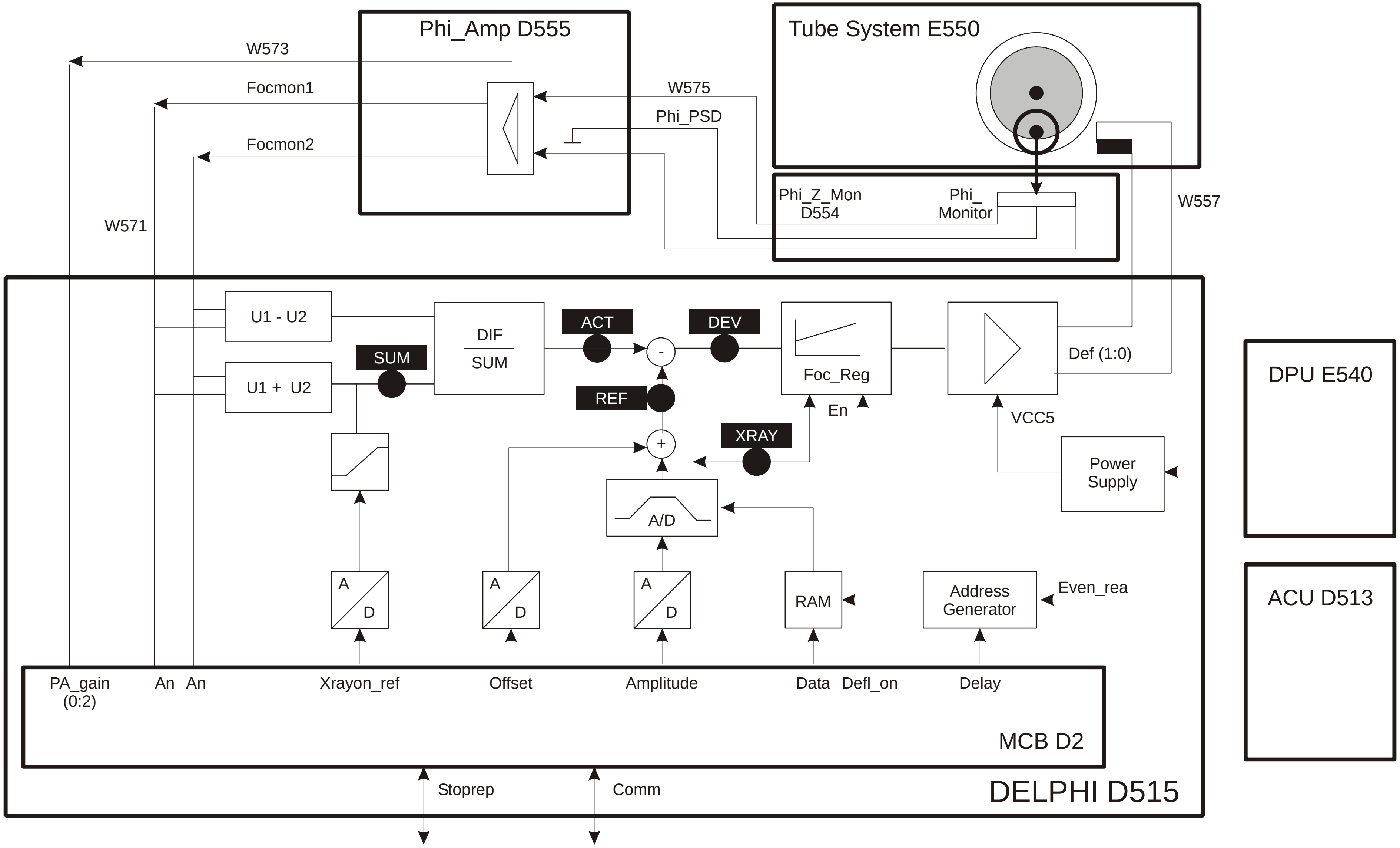

Phi_Amp D555
Tube System E550
W573
Focmon1
Focmon2
W575
Phi_PSD
W571
Phi_Z_Mon
D554
Phi_
Monitor
W557
U1 - U2
U1 + U2
DIF
SUM
SUM
ACT
DEV
REF
XRAY
-
+
Foc_Reg
En
Def (1:0)
VCC5
DPU E540
Power
Supply
A/D
A
D
A
D
A
D
RAM
Address
Generator
Even_rea
ACU D513
PA_gain
(0:2)
An
An
Xrayon_ref
Offset
Amplitude
Data
Defl_on
Delay
MCB D2
Stoprep
Comm
DELPHI D515

Figure 3-63: Focus Deflection 1 Test Points

Signals

Delay The MCB outputs a delay value that is loaded into the delay stage. This delay is needed to synchronize the DMS functions and the focus deflection. The delay value must be determined during the tune-up.

Data The digital nominal deflection curve (trapezoid cube) is written into the RAM.

Even_rea The signal for Even Reading (**Even_rea**) enables the generation of the deflection cycle (supply is delayed by the value set by the MCB). It is used to synchronize the readout sequence of the RAM with DMS functions.

Amplitude

The amplitude of FOCREF can be changed. The MCB outputs a digital amplitude value that is converted by a Digital/Analog Converter (DAC) into a voltage. This voltage is connected to the signal generator. By changing the reference input voltage, the analog output (amplitude) of the signal generator can be changed. The change of the amplitude must be done to align the focus position to the actual detector position.

Offset An offset value can be added to the FOCREF value. The MCB outputs the digital offset value to the DAC. The corresponding analog voltage is then added to FOCREF. The offset is needed to:

- Align the focus position to the actual detector position.
- Compensate the mechanical offset between detector and Phi_Monitor (Position Sensitive Device, PSD) center.

Phi_PSD The current signals from the Phi_Monitor (Position Sensitive Device), depend on radiation intensity and focus position.

Focmon1 The current signal from the Phi_Monitor is converted into a voltage.

Focmon2 The current signal from the Phi_Monitor is converted into a voltage.

PA_gain Phi Amplifier gain (**PA_gain**) can be changed by MCB D2 depending on the selected scan parameter.

VCC5 VCC5 is the 24 VDC supply of the Digital Power Unit 1 (DPU1) for the focus power stage. Supplied via the DELPHI Power Supply.

Def Def is the Deflection Current that is used to deflect the focus position inside the X-ray tube.

Xrayon_ref

Xrayon_ref is the threshold for detecting X-ray and enabling the deflection regulator.

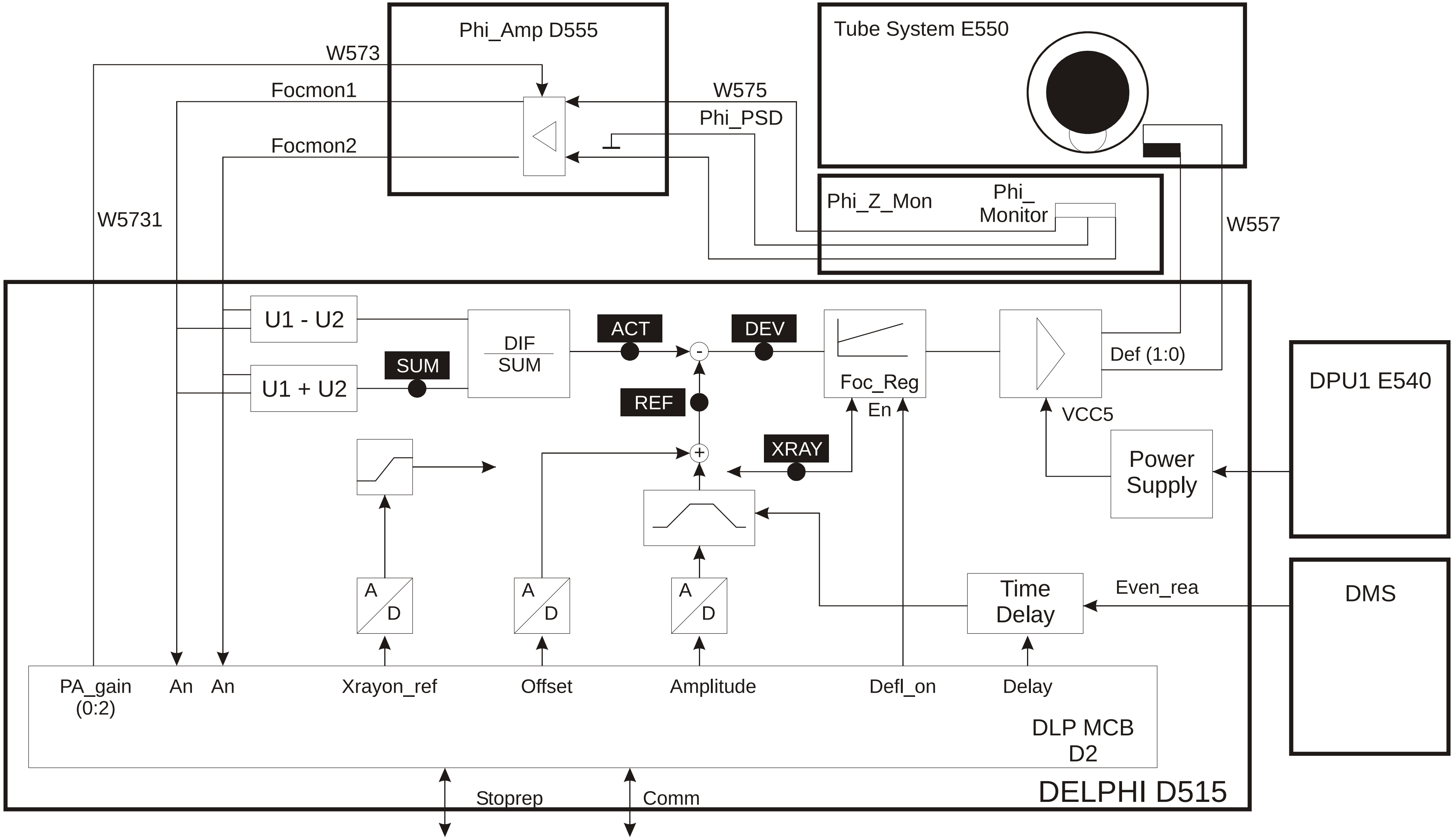

Phi_Amp D555
W573
Focmon1
Focmon2
W575
Phi_PSD
Tube System E550
Phi_Z_Mon
Phi_
Monitor
W5731
W557
U1 - U2
U1 + U2
SUM
DIF
SUM
ACT
DEV
REF
XRAY
-
+
Foc_Reg
En
Def (1:0)
VCC5
Power
Supply
DPU1 E540
DMS
Time
Delay
Even_rea
A
D
A
D
A
D
PA_gain
(0:2)
An
An
Xrayon_ref
Offset
Amplitude
Defl_on
Delay
DLP MCB
D2
DELPHI D515
Stoprep
Comm

Figure 3-64: Focus Deflection 1 Signals

Focus Deflection 2

Figure 3-65 shows the Self Test Function, Automatic Offset Adjustment and the Control Signal Flow of the focus deflection.

Overview

MUX	The processor outputs a digital value of Sumzero/Difzero to the DACs. The analog values are connected to the SUM/DIF circuit to compensate an offset. The result is checked via the analog multiplexer and the D2 ADC input.
MCB D2	The function of the Focus Deflection Circuit is controlled and monitored by the processor located on the MCB D2. Communication between the processor and the Mx 8000 system takes place via the CAN.

Signals

DIF	DIF represents the actual focus position above the Phi_Monitor (Position Sensitive Device, PSD), but as influenced by the dose rate.
Fil_dose	The level of the signal Fil_dose is proportional to the actual radiation intensity emitted by the X-ray tube. Fil_dose is derived from the signal SUM. It is used in the generator as the feedback signal of the actual dose rate during the DR_Ctrl mode.
Xray_on	Xray_on is set if the signal SUM exceeds the limit, that is adjusted with Xrayon_Ref, i.e. if radiation is switched on. Xray_on is used by the filament circuit to switch-over from FIL-Ctrl to DR-Ctrl, i.e. Filament to dose rate regulation.
PA_test	Preamplifier Test (PA_test) switches the D555 preamplifier on in a test mode. By this a known voltage (approximately 1 VDC) is sent from D555 to D515. This mode is used after powering-up of D515 to check the preamplifier, connectors, cables, and other system components.
Sumzero	The processor output Sumzero is used to adjust the offset of the SUM amplifier. If U1=U2=0 volt (during H.V. off), the value of SUM must be zero volts.
Difzero	The processor output Difzero is used to adjust the offset of the DIF-amplifier. If U1=U2=0 volt (during H.V. off) the value of DIF must be zero volts.

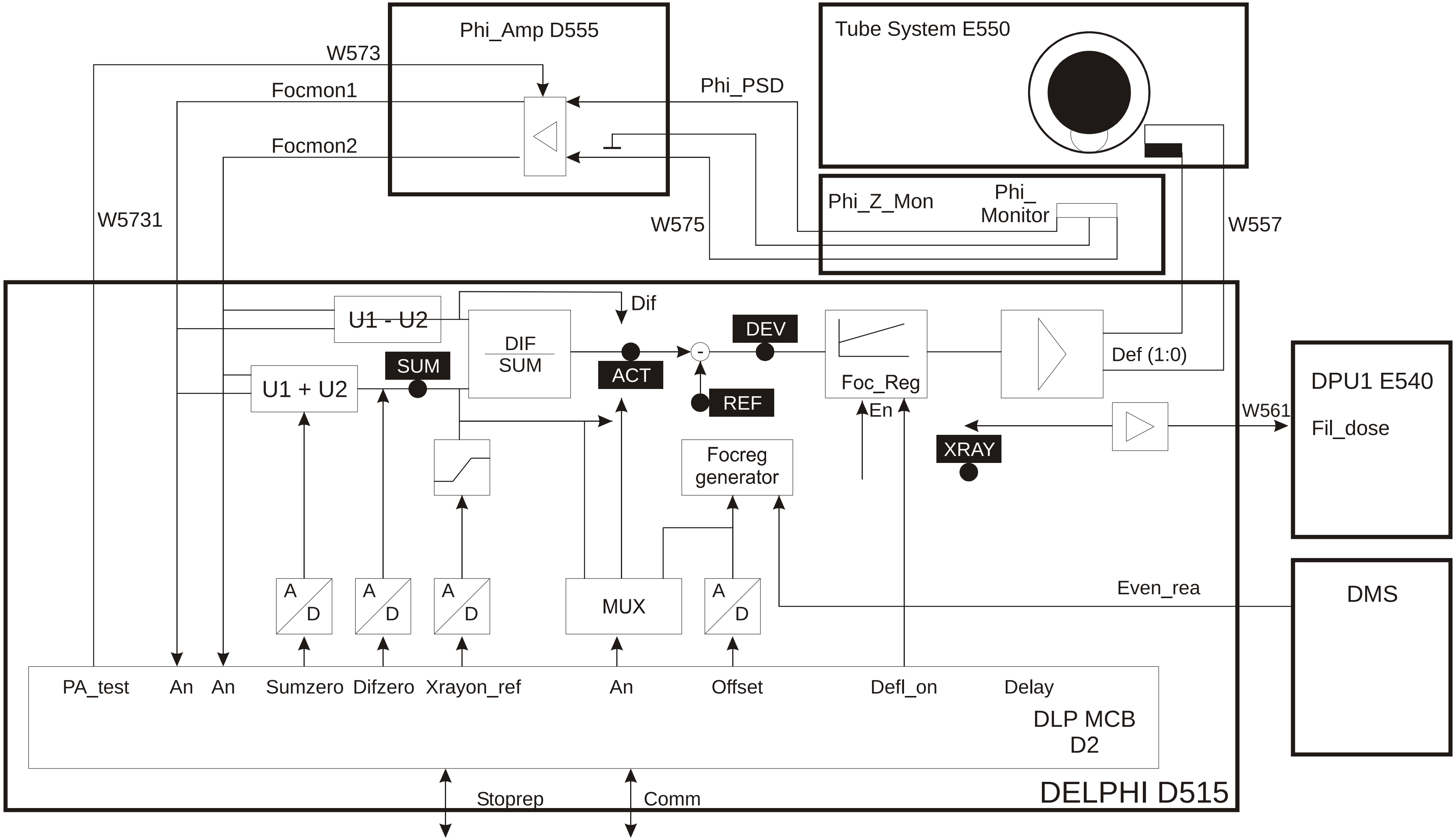

Phi_Amp D555
Tube System E550
W573
Focmon1
Phi_PSD
Focmon2
W5731
W575
Phi_Z_Mon
Phi_
Monitor
W557
U1 - U2
Dif
DEV
DIF
SUM
SUM
U1 + U2
ACT
REF
Foc_Reg
En
Def (1:0)
DPU1 E540
Fil_dose
W561
XRAY
Focreg
generator
A
D
A
D
A
D
MUX
A
D
Even_rea
DMS
PA_test
An
An
Sumzero
Difzero
Xrayon_ref
An
Offset
Defl_on
Delay
DLP MCB
D2
Stoprep
Comm
DELPHI D515

Figure 3-65: Focus Deflection 2 - Test Points

Z-Control

Overview

The Z-Control Circuit positions the A-Plane Collimator according to the focal spot “Z-movement” during a scan.

Z-Monitor The Z_Monitor (Position Sensitive Device, PSD) measures the Z-position of the focus during the scan.

M1/M2 Two stepping motors with a 1:80 gear are mounted to the A-Plane Collimator. The collimator position is controlled by the motor controller of the D514.

E1/E2 The Rotary Encoders are mechanically connected to the stepping motors. They generate two 90× phase-shifted pulses and an index pulse. These pulses are used to determine the actual collimator position.

LS1/LS2 LS1/LS2 is the Optical Limit Switch used to generate the reference position for the collimator together with the encoder index pulse.

Motor Controller

The Motor Controllers evaluate the pulses of the Rotary Encoder. A and B pulses are counted starting from the reference position. The result is the actual collimator position that is compared to the nominal collimator position.

Power Stage

The Power Stages supply the M1/M2 Stepping Motors. The Stepping Motors receive their positioning data from the Motor Controller. A driver needs 24 VDC (pwr24) power supply, that is switched on by the Zcon Power Supply.

MCB D2 The function of the Z-Control Circuit is controlled and monitored by the processor located on D2 MCB. Communication between the processor and the Mx8000 takes place via the CAN.

LEDs

Rdy1 Ready 1 lights when Motor 1 reaches its nominal position.

Rdy2 Ready 2 lights when Motor 2 reaches its nominal position.

Pwr24 Pwr24 lights when there is a 24 VDC power supply for the power stages greater than 18 V.

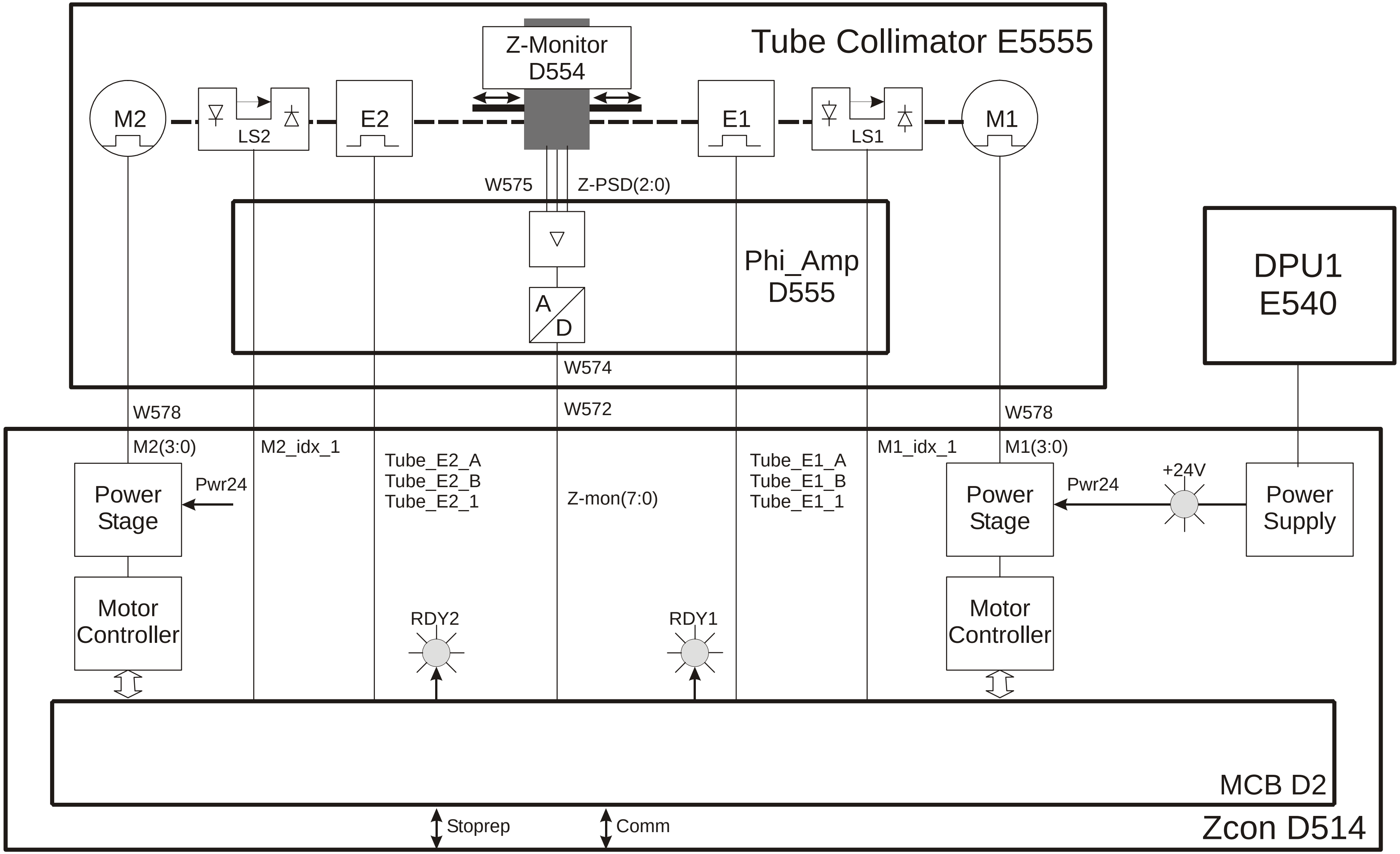

Tube Collimator E5555
Z-Monitor
D554
M2
LS2
E2
E1
LS1
M1
W575
Z-PSD(2:0)
Phi_Amp
D555
A
D
W574
DPU1
E540
W578
W572
W578
M2(3:0)
M2_idx_1
Tube_E2_A
Tube_E2_B
Tube_E2_1
Z-mon(7:0)
Tube_E1_A
Tube_E1_B
Tube_E1_1
M1_idx_1
M1(3:0)
Power
Stage
Pwr24
Power
Stage
Pwr24
+24V
Power
Supply
Motor
Controller
RDY2
RDY1
Motor
Controller
MCB D2
Stoprep
Comm
Zcon D514

Figure 3-66: Z-Control LEDs

Test points

IDX2_1	The Index Pulse from the Optical Limit Switch LS2.
IDX1_1	The Index Pulse from the Optical Limit Switch, LS1.
TRG	The Trigger Signal for troubleshooting (Lab use only).
XRAY	Indicates that Radiation on is detected by the DELPHI, D515.

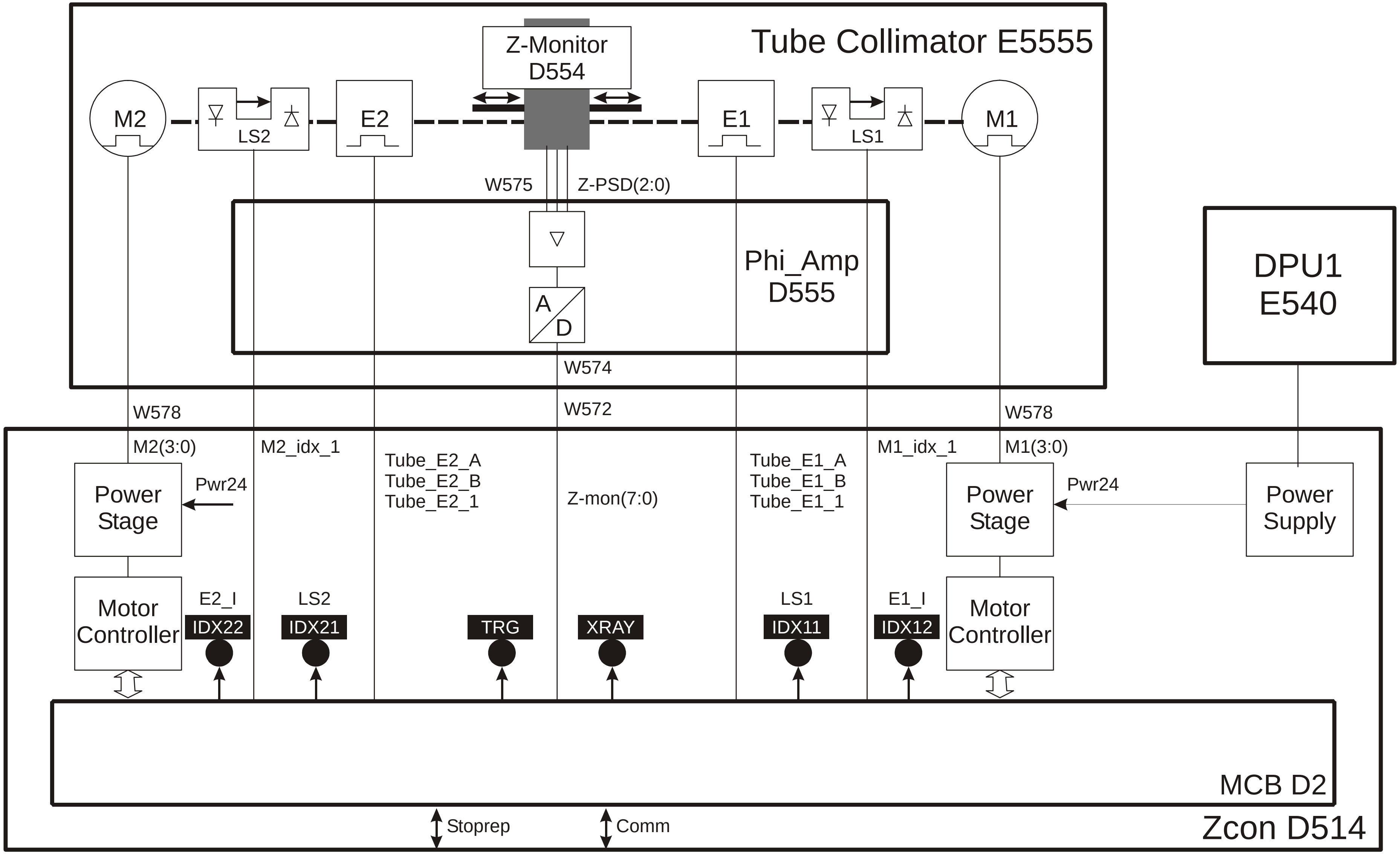

Tube Collimator E5555
Z-Monitor
D554
M2
LS2
E2
E1
LS1
M1
W575
Z-PSD(2:0)
Phi_Amp
D555
A
D
W574
DPU1
E540
W578
W572
W578
M2(3:0)
M2_idx_1
Tube_E2_A
Tube_E2_B
Tube_E2_1
Tube_E1_A
Tube_E1_B
Tube_E1_1
M1_idx_1
M1(3:0)
Power Stage
Pwr24
Z-mon(7:0)
Power Stage
Pwr24
Power Supply
Motor Controller
E2_I
IDX22
LS2
IDX21
TRG
XRAY
LS1
IDX11
E1_I
IDX12
Motor Controller
MCB D2
Stoprep
Comm
Zcon D514

Figure 3-67: Z-Control Test Points

Signals

Z_PSD	Z_PSD are the Current Signals from the Z_monitor (Position Sensitive Device, PSD), that depend on radiation intensity and focus position.
M1(3:0)	M1(3:0) is the Power Supply signal for Stepping Motor One (four phases). M1(3:0) creates 200 halfsteps/revolution.
M2(3:0)	M2(3:0) is the Power Supply signal for Stepping Motor Two (four phases). M2(3:0) creates 200 halfsteps/revolution.
M1_IDX_1	M1_IDX_1 is the Index Pulse from the Optical Limit Switch, LS1. One pulse/revolution of the gear output shaft creates 80 revolutions of Motor M1.
M2_IDX_1	M2_IDX_1 is the Index Pulse from the optical limit switch LS2. One pulse/revolution of the gear output shaft creates 80 revolutions of Motor M2.
Tube_E1_A/B/1	Pulses generated from the Rotary Encoder E1 are:Tube_E1_A: 400 pulses/revolution of the Motor ShaftTube_E1_B: 400 pulses/revolution of the Motor ShaftTube_E1_I: One Index Pulse/revolution of the Motor Shaft
Tube_E2_A/B/1	Pulses generated from the Rotary Encoder E2 are:Tube_E2_A: 400 pulses/revolution of the motor shaftTube_E2_B: 400 pulses/revolution of the motor shaft 90× phase shiftedTube_E2_I: One Index Pulse/revolution of the motor shaft.
Z-mon(7:0)	The Digital Output Signals of the D555 phi_amplifier are connected as differential signals Z_monitor (Z_mon 7:0) to the D514. On the D514, the signals are then connected to the digital input of the MCB. The MCB uses the digital information as the actual focus position value.
Pwr24	24 VDC power supply voltage is generated in the Digital Power Unit 1 (DPU1).

A-Plane Collimation

The Z-Control Circuit positions the A-Plane Collimator, before a scan, according to the selected slice thickness.

Overview

Z-Control The Z-Control Circuit has the task of positioning the A-Plane Collimator according to the focal spot-movement during a scan.

Z-Monitor
The Z-Monitor (Position Sensitive Device, PSD) measures the Z-position of the focus during the scan.

M1/M2 Two Stepping Motors with a 1:80 gear are mounted to the A-Plane Collimator. The motors are controlled (i.e. the collimator position is controlled) by the motor controller of the D514.

E1/E2 The Rotary Encoders are mechanically connected to the stepping motors. They generate two 90× phase shifted pulses and an index pulse. These pulses are used to determine the actual collimator position.

LS1/LS2 LS1/LS2 is the Optical Limit Switch that generates the reference position for the collimator together with the encoder index pulse.

Motor Controller
The Motor Controllers evaluate the pulses of the Rotary Encoder. A and B pulses are counted starting from the reference position. The result is the actual collimator position that is compared to the nominal collimator position.

Power Stage
The Power Stages supply the M1/M2 Stepping Motors. The Stepping Motors receive their positioning data from the motor controller.
The Output Drivers of the Power Stage need 24 VDC (pwr24) that are switched on by the Zcon Power Supply.

D2, MCB The function of the Z-Collimation circuit is controlled and monitored by the processor located on D2 MCB. Communication between the processor and the Mx8000 takes place via the CAN.

LEDs

Rdy2 Lights when motor two reached its nominal position.

Rdy1	Lights when motor one reached its nominal position.
24VDC	Lights when the power supply for the power stages is greater 18 V.

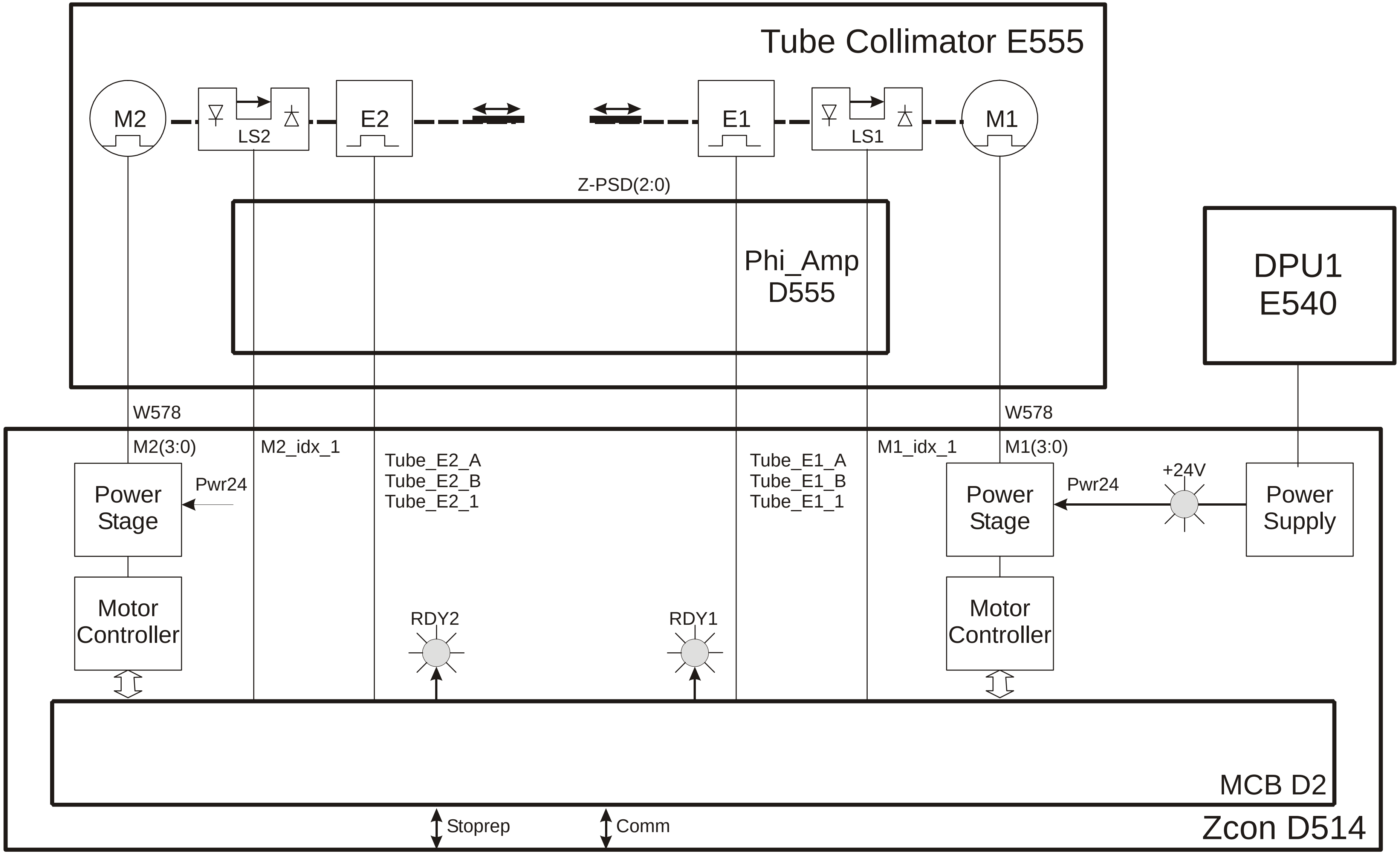

Tube Collimator E555
M2
LS2
E2
E1
LS1
M1
Z-PSD(2:0)
Phi_Amp
D555
DPU1
E540
W578
W578
M2(3:0)
M2_idx_1
Tube_E2_A
Tube_E2_B
Tube_E2_1
Tube_E1_A
Tube_E1_B
Tube_E1_1
M1_idx_1
M1(3:0)
Power Stage
Pwr24
Power Stage
Pwr24
+24V
Power Supply
Motor Controller
RDY2
RDY1
Motor Controller
MCB D2
Stoprep
Comm
Zcon D514

Figure 3-68: A-Plane Collimation—LEDs

Test Points

IDX2_1	The Index pulse from the Optical Limit Switch LS2.
IDX1_1	The Index pulse from the Optical Limit Switch LS1.
TRG	The Trigger signal for troubleshooting (Lab use only).
XRAY	Indicates Radiation on is detected by the DELPHI, D515.

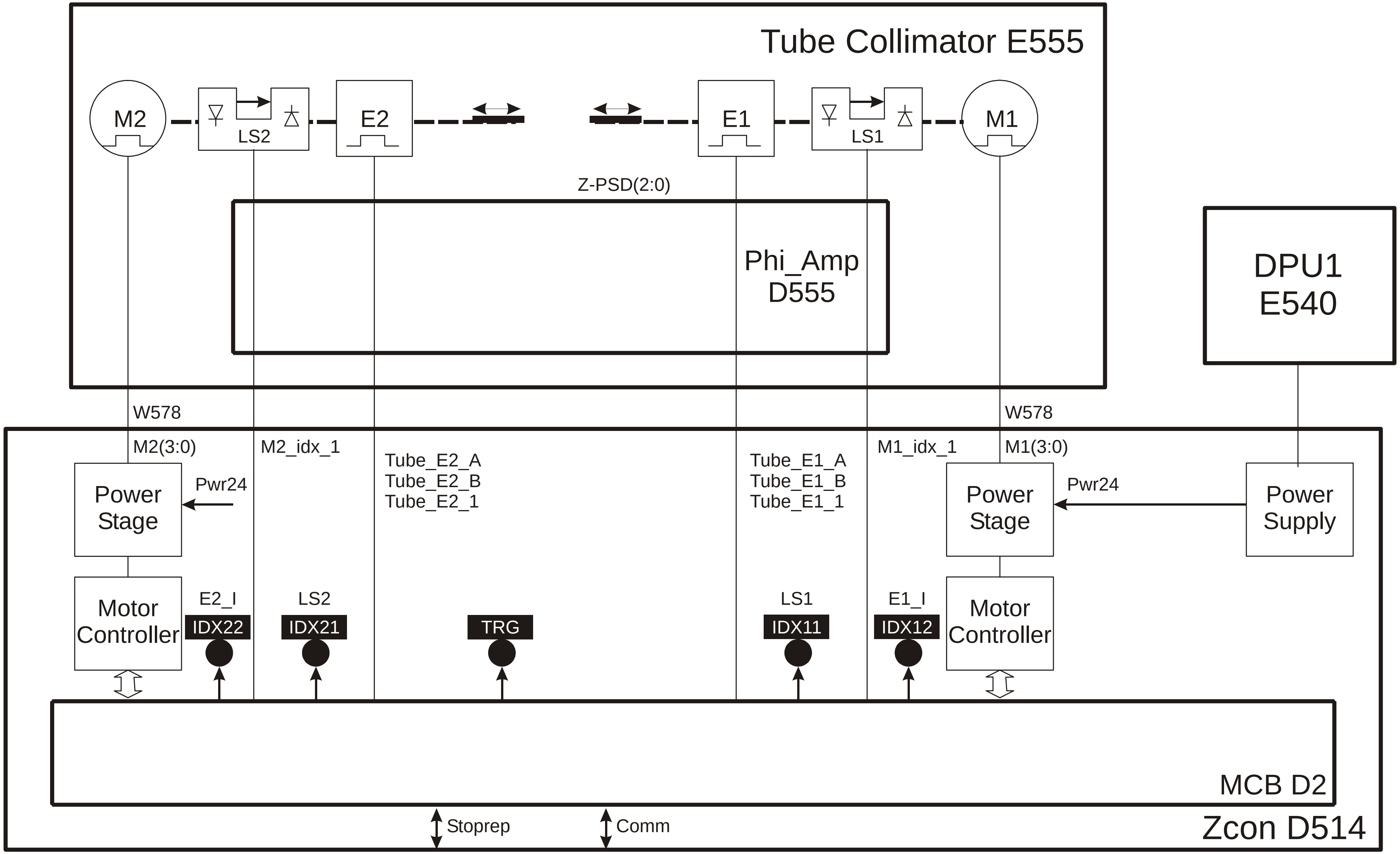

Tube Collimator E555
M2
LS2
E2
E1
LS1
M1
Z-PSD(2:0)
Phi_Amp
D555
DPU1
E540
W578
W578
M2(3:0)
M2_idx_1
Tube_E2_A
Tube_E2_B
Tube_E2_1
Tube_E1_A
Tube_E1_B
Tube_E1_1
M1_idx_1
M1(3:0)
Power Stage
Pwr24
Power Stage
Pwr24
Power Supply
Motor Controller
E2_I
IDX22
LS2
IDX21
TRG
LS1
IDX11
E1_I
IDX12
Motor Controller
MCB D2
Stoprep
Comm
Zcon D514

Figure 3-69: A-plane Collimation—Test Points

Signals

Z_PSD The current signals from the Z_monitor (Position Sensitive Device, PSD), that are depending on radiation intensity and focus position

M2(3:0) Power Supply for the Stepping Motor 2 (four phases)—200 half steps/revolution

M1(3:0) Power Supply for the Stepping Motor 1 (four phases)—200 half steps/revolution

M1_IDX_1

Index pulse from the Optical Limit Switch LS1 (One pulse/revolution of the Gear Output Shaft—i.e. 80 revolutions of the motor M1)

M2_IDX_1

Index pulse from the Optical Limit Switch LS2 (One pulse/revolution of the gear output shaft—i.e. 80 revolutions of the motor M2)

Tube_E2_A/B/1

Pulses generated from the rotary encoder E2 are:

- Tube_E2_A: 400 pulses/revolution of the motor shaft
- Tube_E2_B: 400 pulses/revolution of the motor shaft 90× phase shifted
- Tube_E2_1: 1 index pulse/revolution of the motor shaft

Tube_E1_A/B/1

Pulses generated from the Rotary Encoder E1 are:

- Tube_E1_A: 400 pulses/revolution of the motor shaft
- Tube_E2_B: 400 pulses/revolution of the motor shaft 90× phase shifted
- Tube_E1_1: 1 index pulse/revolution of the motor shaft

Z-mon(7:0)

The Digital Output Signals of the D555, phi_amplifier are connected as differential signals Z_monitor (Z_mon 7:0) to the D514. On the D514 the signals are then connected to the digital input of the MCB. The MCB uses the digital information as actual focus position value.

Pwr24 24 VDC power supply voltage is generated in the Digital Power Unit 1 (DPU1)

P-Plane Collimation

Collimation on the side of the detector is performed by the P-Plane Collimator with its motor and encoder and controlled by DELPHI, D515.

Overview

Encoder The actual P-Plane Collimator position is fed back by using a position encoder that is located at the Detector Collimation. The encoder outputs three signals that are connected as Inc (5:0) to the DELPHI.

Optical Limit Switches

The Optical Limit Switches (double light barriers) prevent mechanical collision of the P-Plane and the Detector Assembly. They stop the collimation movement at a minimum and maximum aperture.

Motion Control

The three encoder signals are processed by the Motion Control Circuit on D515. This circuit has an Internal Actual Position Counter that is incremented or decremented by the Ch0/1 signals. The index pulse is set if the collimator is positioned at a reference aperture.

The Motion Control Circuit compares the nominal position sent by the MCB with its Internal Actual Positioning Counter. According to the difference it detects, the Motion Control Circuit sets the signal Sign.

Motor Driver

The Motor Driver connects a 24 V pulse with modulated voltage to the M1 motor of the P-Plane Collimator. The motor rotates in the clockwise or counterclockwise direction depending on the Sign signal, thus changing the P-Plane aperture.

Current Limit

In case of malfunctions of the Optical Limit Switches, the MCB has to detect the mechanical limit (stalled motor) by sensing the motor current. To do this, the motor current has to be limited to a switchable value. Switching from the higher to the lower limit is done by the MCB after the start phase of the motor with the signal Mot_I_limit. Also the state of the current limiting has to be sensed by the MCB with the signal I_high.

D2, MCB The function of the Collimator Control Circuit is controlled and monitored by the processor located on D2 (Master Control and Base Hardware Board). Communication between the processor and the Mx8000 system takes place via the CAN.

Switches

Service	Selects the Service Operation to open and close the Detector Diaphragm manually.
Open	Moves the Detector Diaphragm to a bigger aperture during service operation.
Close	Moves the Detector Diaphragm to a smaller aperture during service operation.

LEDs

Service	Service operation is selected.
IDX	IDX indicates the display of the Position Encoder index pulse.
LIM	LIM indicates that the Optical Limit Switch is active.

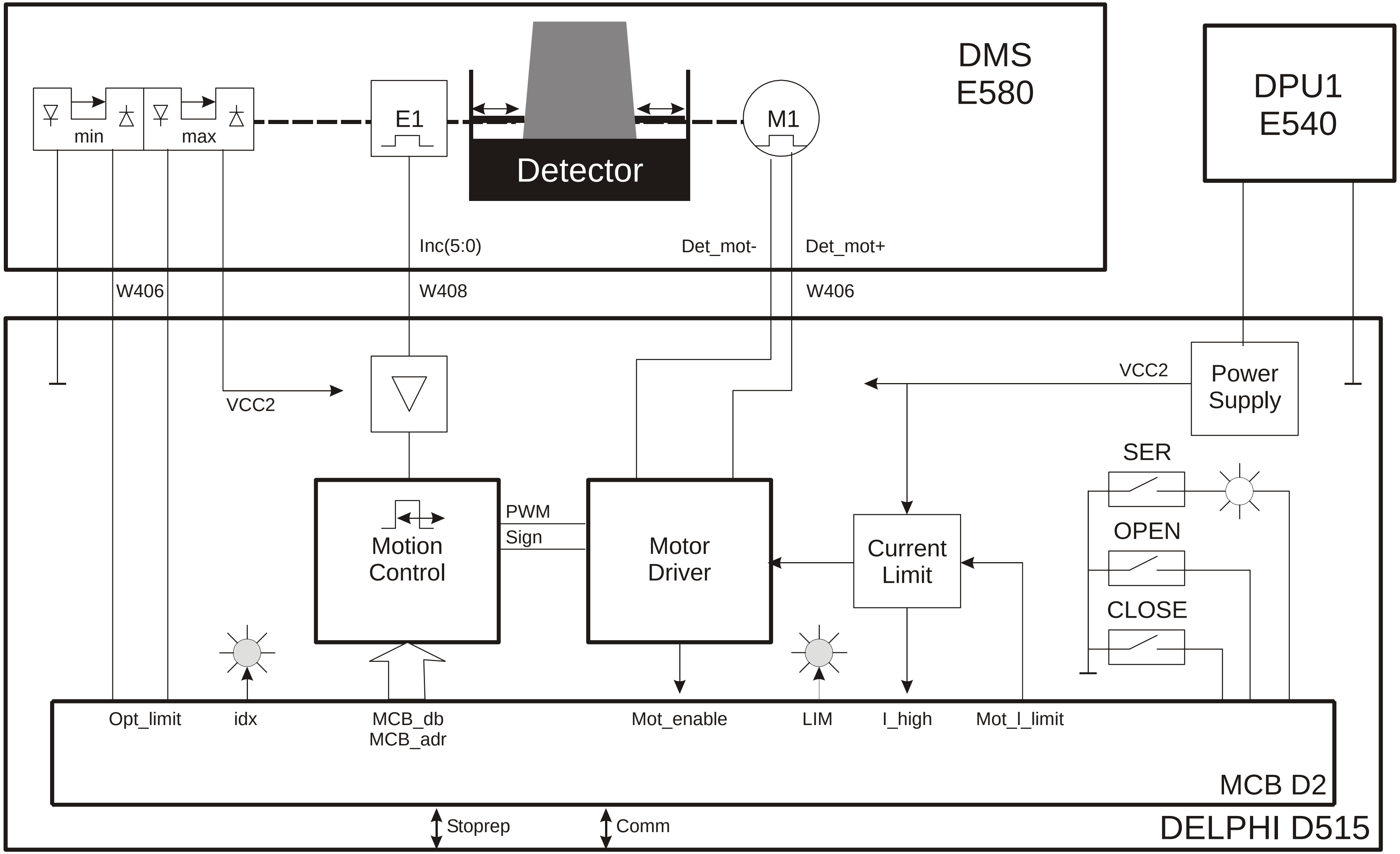

DMS
E580
DPU1
E540
min
max
E1
Detector
M1
Inc(5:0)
Det_mot-
Det_mot+
W406
W408
W406
VCC2
VCC2
Power
Supply
SER
OPEN
CLOSE
PWM
Sign
Motion
Control
Motor
Driver
Current
Limit
Opt_limit
idx
MCB_db
MCB_adr
Mot_enable
LIM
I_high
Mot_I_limit
MCB D2
Stoprep
Comm
DELPHI D515

Figure 3-70: Detector Collimation

Test Point

TRG	The trigger signal for troubleshooting (Lab use only).

Signals

Opt_limit	Optical limit switch reached e.g. the movement is stopped in one direction
Inc(5:0)	Output signals of the position encoder. Channel0, Channel1 and Index transferred as differential signals
Index	Index pulse of the position encoder is active (one/revolution)
CH0	Channel0 encoder increment pulses (100,000/revolution)
CH1	Channel1 encoder increment pulses 90× phase shifted (10,000/rev)
MCB_db/MCB_adr	Data and address for the parallel data path to send the nominal diaphragm position from the MCB to the motion control
PWM	Pulse width modulated input voltage for the motor driver determines the speed of the motor movement
Sign	Input signal for the motor driver, determines the direction of the motor movement
Det_mot	Motor supply voltage. Pulse width modulated 24 V for variable motor speed
Mot_enable	Motor_enable enables the output of the motor power controlled by the MCB
I_high	State of the current limiting has to be sensed by the MCB with the signal Current High (**I_high**) **I_high** is active if the current limit is exceeded.
(Mot)_I_limit	Motor Current Limit (**Mot_I_limit**) switches the current limit from a higher value for acceleration to a lower value during normal run
VCC2	24 V to supply the diaphragm motor and the optical limit switches

Light Marker

Figure 3-71 shows the hardware of the light marker circuit that consists of DELPHI D515 with the power source and the control circuit.

Overview

The light markers LIMA_R_1-R4 (E581-584) are built up of four Low Power Laser Diodes with a Slot Collimator. The lasers are switched on if the signal Lightmarker_ON is set by the MCB, D2. 5 VDC is then connected as Lima_VCC via a transistor.

MCB The processor located on D2 MCB controls the function of the light marker circuit. Communication between the processor and the Mx8000 takes place via the CAN.

Signals

Lightmarker_on
Switches on the transistor to connect 5 VDC to the light markers.

Lima_rtn Ground for the 5 VDC to the light markers.

Lima_VCC
5 VDC to the light markers.

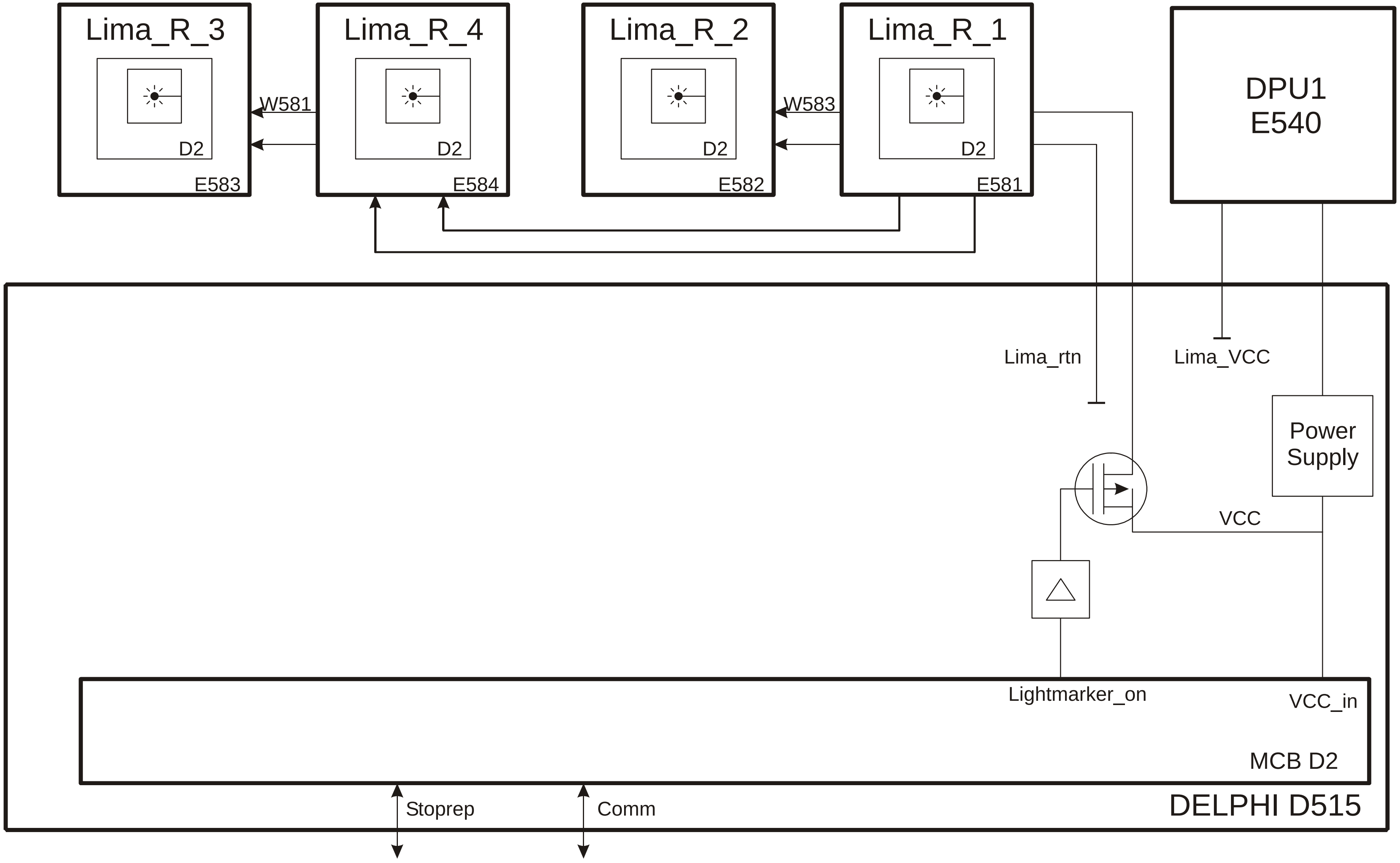

Lima_R_3
D2
E583
W581
Lima_R_4
D2
E584
Lima_R_2
D2
E582
W583
Lima_R_1
D2
E581
DPU1
E540
Lima_rtn
Lima_VCC
Power Supply
VCC
Lightmarker_on
VCC_in
MCB D2
Stoprep
Comm
DELPHI D515

Figure 3-71: Light Marker

Air Scan Compensator

The Air Scan Compensator is an additional attenuator in the Tube Collimator Box that is used to attenuate the radiation of air scans.

Overview

The compensator consists of an aluminum bracket, that swings in and out of the X-ray beam. The bracket is driven by a 24 VDC-motor with a gearbox. The motor runs only in one direction. It moves alternately from Position One to Position Two.

Light Barrier

Light Barrier One is activated (interrupted) if the compensator is in the out-position. Light Barrier Two is activated (interrupted) if the compensator is in the in-position.

Motor Controller

The MCB enables the Motor Controller with the signal Start Compensator (Start_comp) to change the position of the compensator and disables the Motor Controller when the Correct Light Barrier sends a feedback.

Power supply

The 24 VDC (pwr24) for the motor and 5 VDC (VCC) for the limit switches are provided by the ZCON Power Supply and monitored in the ZCON.

D2, MCB The function of the Air Scan Compensator Control Circuit is controlled and monitored by the processor located on D2 (Master Control and Base Hardware Board). Communication between the processor and the Mx8000 system takes place via the CAN.

LEDs

COMP COMP lights when the Compensator is located inside the X-ray beam.

Pwr24 Pwr24 lights when the 24 VDC power supply for the Power Stages is greater 18 V.

Signals

Start_comp

Start Compensator (Start_comp) enables the Motor Controller to change the position of the compensator and disables the Motor Controller when the correct position is reached.

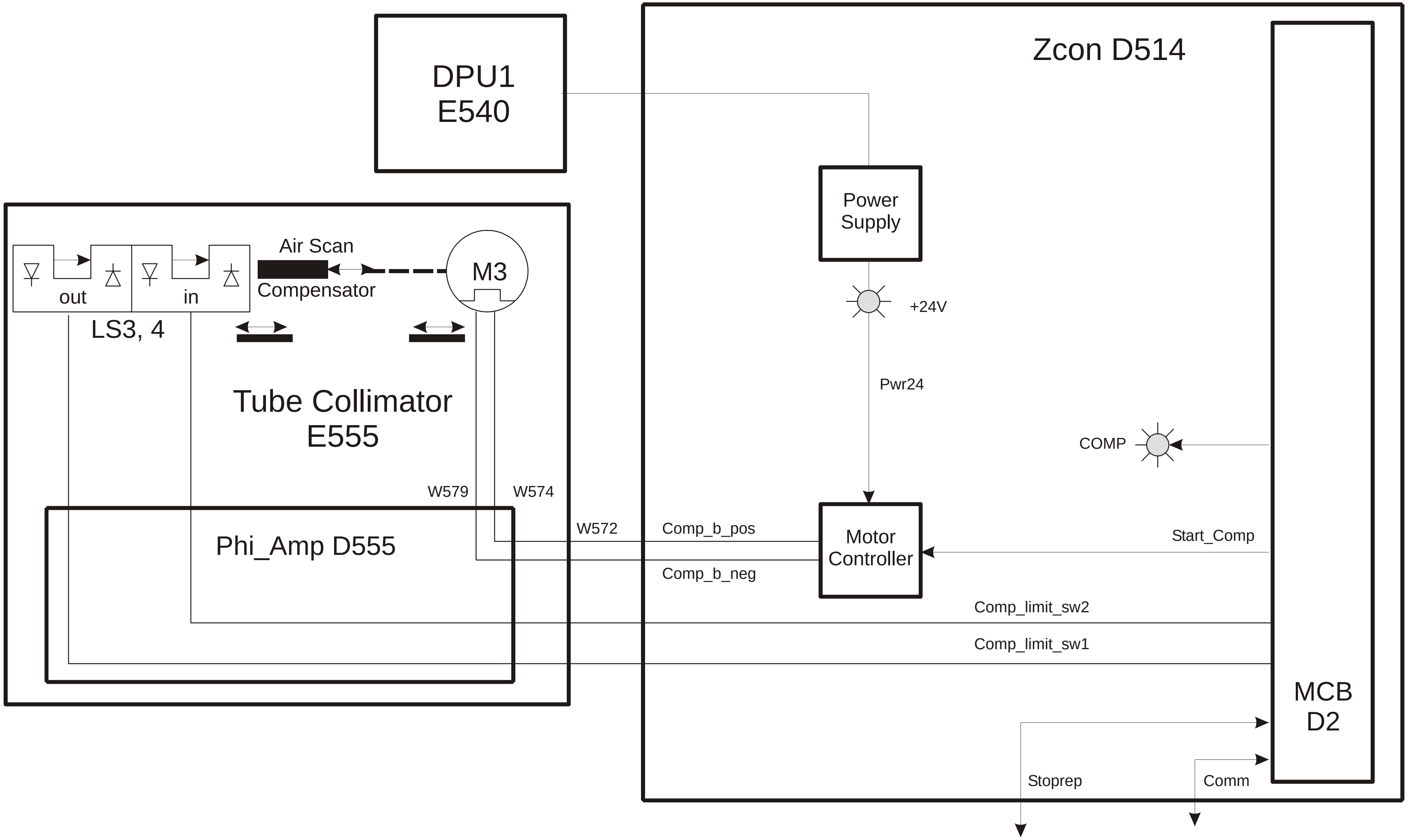

DPU1
E540
Zcon D514
Power Supply
+24V
Pwr24
COMP
Motor Controller
Start_Comp
Comp_b_pos
Comp_b_neg
W572
W579
W574
Comp_limit_sw2
Comp_limit_sw1
MCB
D2
Stoprep
Comm
Air Scan
Compensator
M3
out
in
LS3, 4
Tube Collimator
E555
Phi_Amp D555

Figure 3-72: Air Scan Compensator

Ultra High Resolution (UHR) Collimator

The Ultra High Resolution (UHR) Collimator is a comb-shaped filter, that increases the high contrast resolution.

Overview

The Ultra High Resolution Collimator is located between P-Plane Collimator and detector elements and can be moved on top of the center channels for some special modes.

Motor Controller

The Zcon MCB sets the Enable and Direction signal for the Motor Controller that drives the DC-motor with 24 V. To ensure the accuracy of the mechanical position of the UHR Collimator, the collimator is pushed permanently against the Mechanical End Stop of the in-position.

Optical Limit Switches

Light barrier 1 is activated (interrupted) if the UHR is in the out-position. The motor current is switched off in this position. Light Barrier 2 is activated (interrupted) if the UHR is in the in-position.

Power Supply

The 24 VDC (pwr24) for the motors and 5 VDC (VCC) for the Limit Switches are provided by the ZCON Power Supply and monitored there.

MCB The function of the UHR Collimator Control Circuit is controlled and monitored by the processor located on D2 MCB. Communication between the processor and the Mx 8000 takes place via the CAN.

Switches

SER	Service Function for the movement of the UHR Collimator is on.
UHR_IN	The UHR Collimator moves into the X-ray beam.
UHR_OUT	The UHR Collimator moves out of the X-ray beam.

LEDs

SER	Service for UHR Collimator is active.
UHR	The UHR Collimator is located inside the X-ray beam (not in out position).
HI_CUR	The Current limitation for the UHR-motor is active (signal HighCurrent active).
UHR_LIM	The end switches for the UHR Collimator are reached (signal UHR_Limit_Sw1 or 2 active).

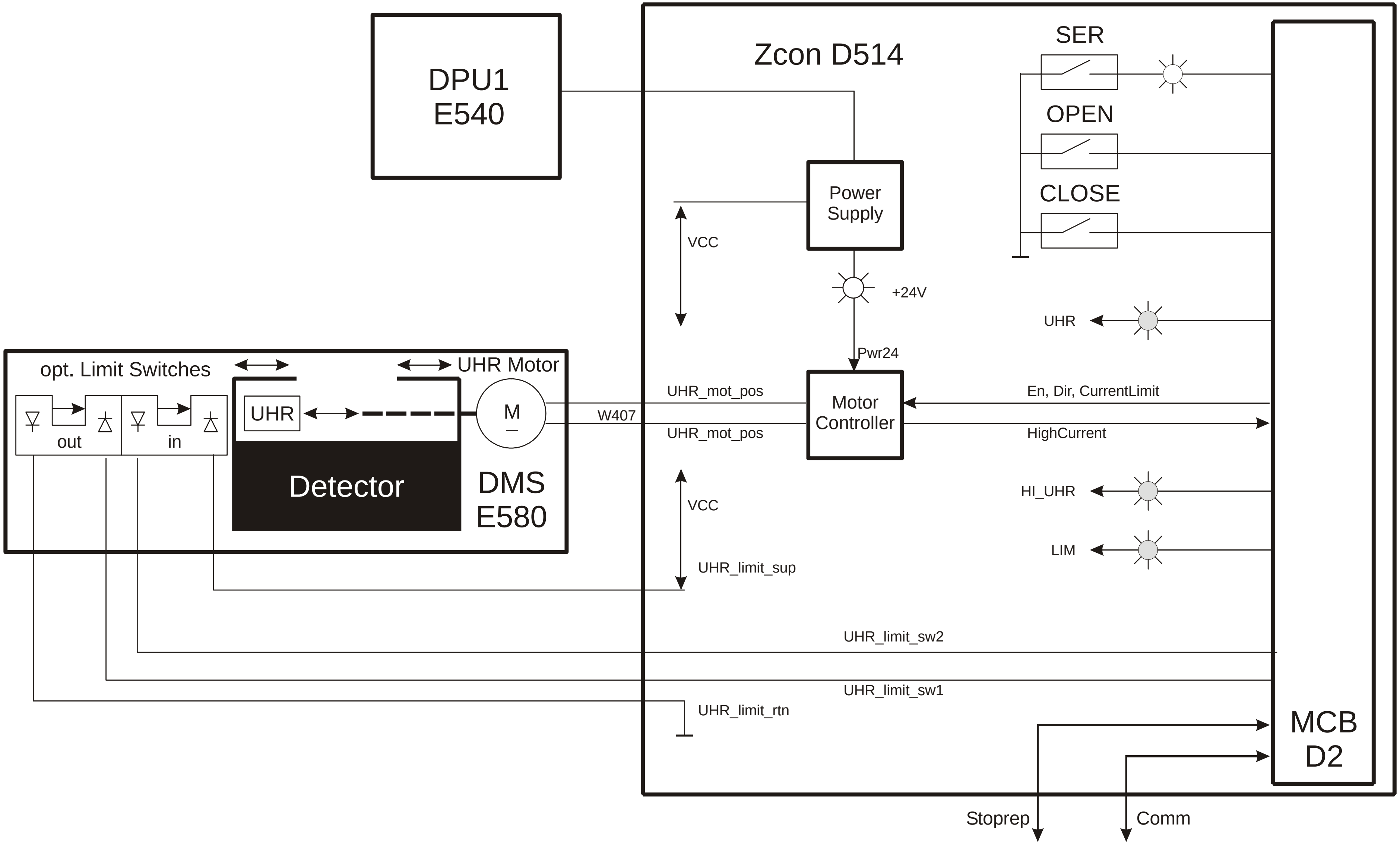

DPU1
E540
Zcon D514
SER
OPEN
CLOSE
Power Supply
VCC
+24V
UHR
Pwr24
opt. Limit Switches
UHR Motor
UHR
M
out
in
Detector
DMS
E580
W407
UHR_mot_pos
UHR_mot_pos
Motor Controller
En, Dir, CurrentLimit
HighCurrent
HI_UHR
VCC
LIM
UHR_limit_sup
UHR_limit_sw2
UHR_limit_sw1
UHR_limit_rtn
MCB
D2
Stoprep
Comm

Figure 3-73: UHR Collimator—LEDs

Signals

UHR_mot_pos/neg
24 V supply for the UHR DC-motor

UHR_limit_sup
UHR limit switch supply with 5 V DC

UHR_limit_sw2
UHR limit switch 2 (UHR_limit_sw2) active, high if the UHR Collimator is inside the beam

UHR_limit_sw1
UHR limit switch 1 (**UHR_limit_sw1**) active, high if the UHR Collimator is outside the beam

En Enable (En) the motor controller to move the UHR Collimator

Dir Direction (Dir) defines the direction of the UHR Collimator movement

CurrentLimit
The signal CurrentLimit switches over the motor current from 350 mA for driving, to the hold current of 175 mA one second after reaching High Barrier 2 (IN). The UHR Collimator is permanently pushed against the Mechanical End Stop of the in-position with the reduced motor current.

HighCurrent
Current limitation for the UHR motor active

Tube Monitoring

The oil temperature and oil pressure of the X-ray tube DURA Akron B is monitored by three signals that are connected to the DELPHI Board located in the C box.

Overview

The cooling of the Tube System is achieved via an Oil-Air Heat Exchanger. As soon as the machine is switched on, the pump is supplied with power that forces an oil flow through the heat exchanger and tube system. The cold Gantry air is then sucked through the heat exchanger to cool down the oil.

S1	S1 is a NTC resistor that has a thermal coupling to the E550 Tube System. Depending on the actual temperature, the voltage level of the signal NTC_pos changes.
S2	The S2 temperature switch is used to monitor the maximum allowed oil temperature of 80°C (176°F). The S2 switches from VCC (5 V) to ground when the temperature is exceeded.
S3	The S3 pressure switch is the Safety Function of the temperature monitoring. If the temperature becomes too high, the internal oil pressure increases thus activating the S3 switch.
MCB	The processor located on D2 MCB controls the function of the Tube Monitoring Circuit. Communication between the processor and the Mx8000 takes place via the CAN.

Signals

NTC_pos, NTC_neg

The analog input AN allows the D2 MCB a continuous monitoring of the actual tube system temperature and temperature gradient. The signals **NTC_pos** and **NTC_neg** are connected to a NTC resistor that has a thermal coupling to the E550 Tube System.

Temp_switch

The Temperature Switch Signal (**Temp_switch**) changes from VCC (5 V) to ground when the maximum allowed temperature of 80°C (176°F) is exceeded. The **Temp_Switch** signal is connected to the Analog input (An) of the D2 MCB, via a filter.

P_switch The Pressure Switch Signal (**P_switch**) changes from VCC (5 V) to ground when the maximum allowed pressure is exceeded. The **P_switch** signal is connected to the Analog input (An) of the D2 MCB, via a filter.

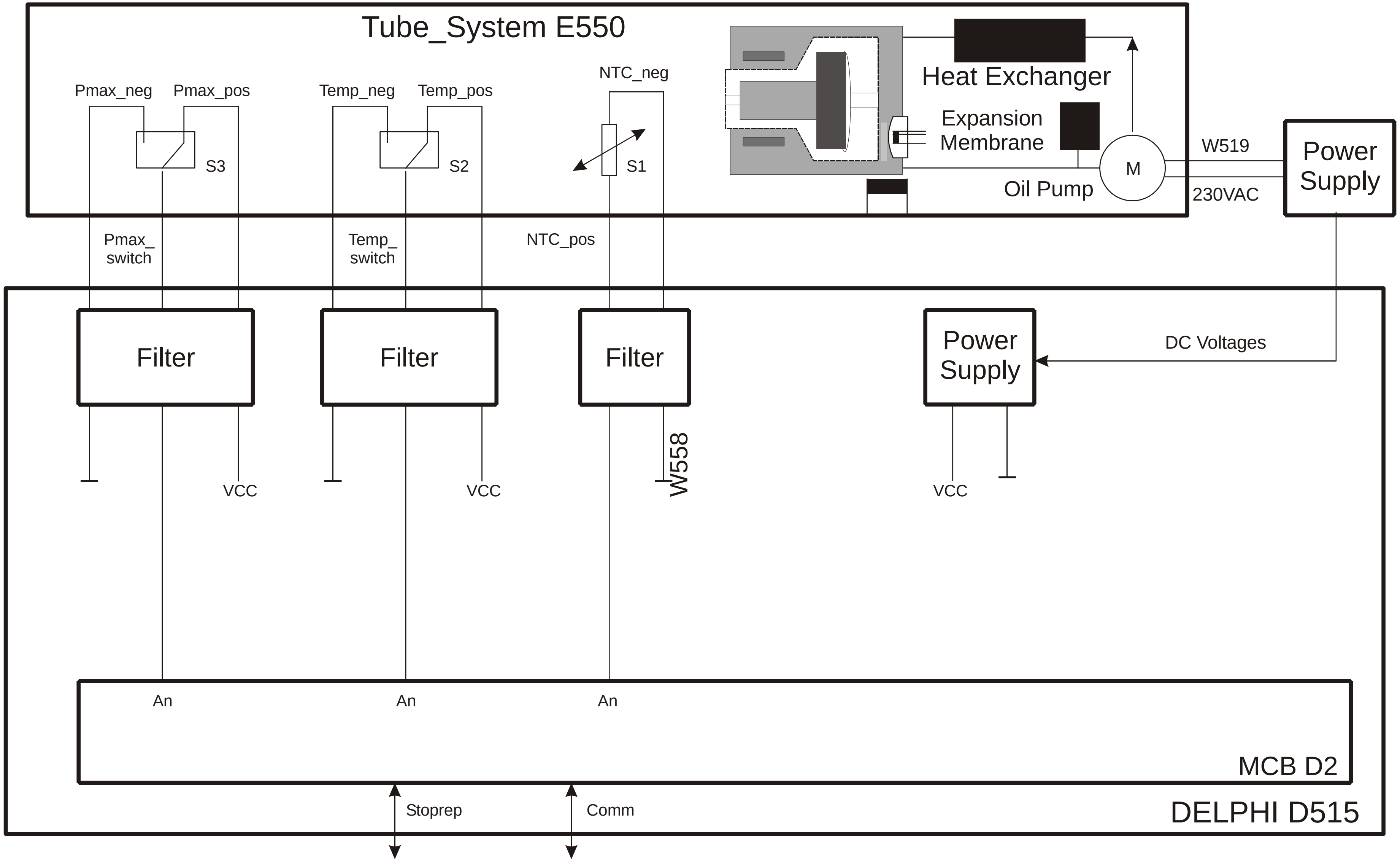

Tube_System E550
Pmax_neg
Pmax_pos
S3
Temp_neg
Temp_pos
S2
NTC_neg
S1
Heat Exchanger
Expansion Membrane
Oil Pump
M
W519
230VAC
Power Supply
Pmax_ switch
Temp_ switch
NTC_pos
Filter
Filter
Filter
Power Supply
DC Voltages
VCC
VCC
W558
VCC
An
An
An
MCB D2
Stoprep
Comm
DELPHI D515

Figure 3-74: Tube Monitoring

Acquisition Control 1

The Acquisition Control Unit (ACU) does the following:

- Loads the scan parameters into the DMS
- Starts and stops the transmission of pre and main-measurement data
- Stops X-ray within a scan
- Establishes a control data link to the Gantry stationary

Overview

LPS The Light Barrier Positioning System (LPS) detects the Rotation Index Pulse (Rot_index) and the Angular Pulses (AP) when the Rotating Slotring passes with its slots through the light barriers. These pulses are transmitted differentially to ACU D513.

Control Data MUX

The data transfer from the stationary to the rotating part is performed with sliprings and the Control Data Multiplexer. Eight bits are transferred in each direction and connected parallel to the logic. The transfer speed is 375 ns/bit.

HTP Counter

The 15 bit Horizontal Table Pulse Counter (HTP Counter) counts the HTPs to determine the end of a topogram or spiral scan. It also monitors the HTP time-out to generate an error message.

AP Counter

The 11 bit Angular Pulse Counter (AP Counter) counts the APs to determine the end of a rot mode with a variable reading number or a spiral scan.

Steady State Generator

The Steady State Generator generates the simulated angular pulses for the static measurement modes. The MCB selects a period of 323, 431 or 646 msec. The angular pulses from the light barrier or the simulated angular pulses are selected, depending on the mode.

Rea Counter

The 24 bit Reading Counter (Rea Counter) uses the Reading Clock (**Rea_clk**) to determine the end of a static scan or a rot mode with fixed reading number.

State Machine

The task of the State Machine is to do the following:

- Supply the room with semi real-time signals.
- Monitor the handshaking protocol and the communication with the room
- Supply the counters for AP, Rea and HTP with control signals
- Generate the X-ray Control Enable (**XC_en**) signal for the MCU, thereby generating X-ray Control Generator (**Xc_gen**) for the generator

ResiMUX

The tasks of the Real-time Signal Multiplexer (ResiMUX) are:

- Multiplexing and demultiplexing of all signals transferred between ACU and Rcom, that are not real-time (transparent signals and static data)
- Transmission and receiving the signals via serial lines

Real-Time Signal Interface

The Real-Time Signal Interface transmits and receives fast signals from the DMS.
The signal lines to the DMS are differential and optoisolated.

MCB D2 The function of the Acquisition Control Circuit is controlled and monitored by the processor located on D2 (Master Control and Base Hardware Board). Communication between the processor and the Mx8000 system takes place via the CAN.

Switches

SER Activate Service Function. Synthetic APs are transmitted for test purposes to the Rotor Communication Card (Rcom) in the DMS.

LEDs

+5V	The 5 VDC power supply is present.
SCAN	The data acquisition in the DMS is running (signal **make_data** is active).
S.TEST	The Self Test of the ACU Board is running (Power on).
K.MCU (NO_SYNCERR)	The Control Data are received without errors from the Master Control Unit (MCU) in the Gantry Stationary.
K.RCOM (RCOM_OK)	The communication with the Rotor Communication Card (Rcom) in the DMS is running without errors.
S.MODE	The Service Function is active. Synthetic APs are transmitted for test purposes to the Rotor Communication Card (Rcom) in the DMS.

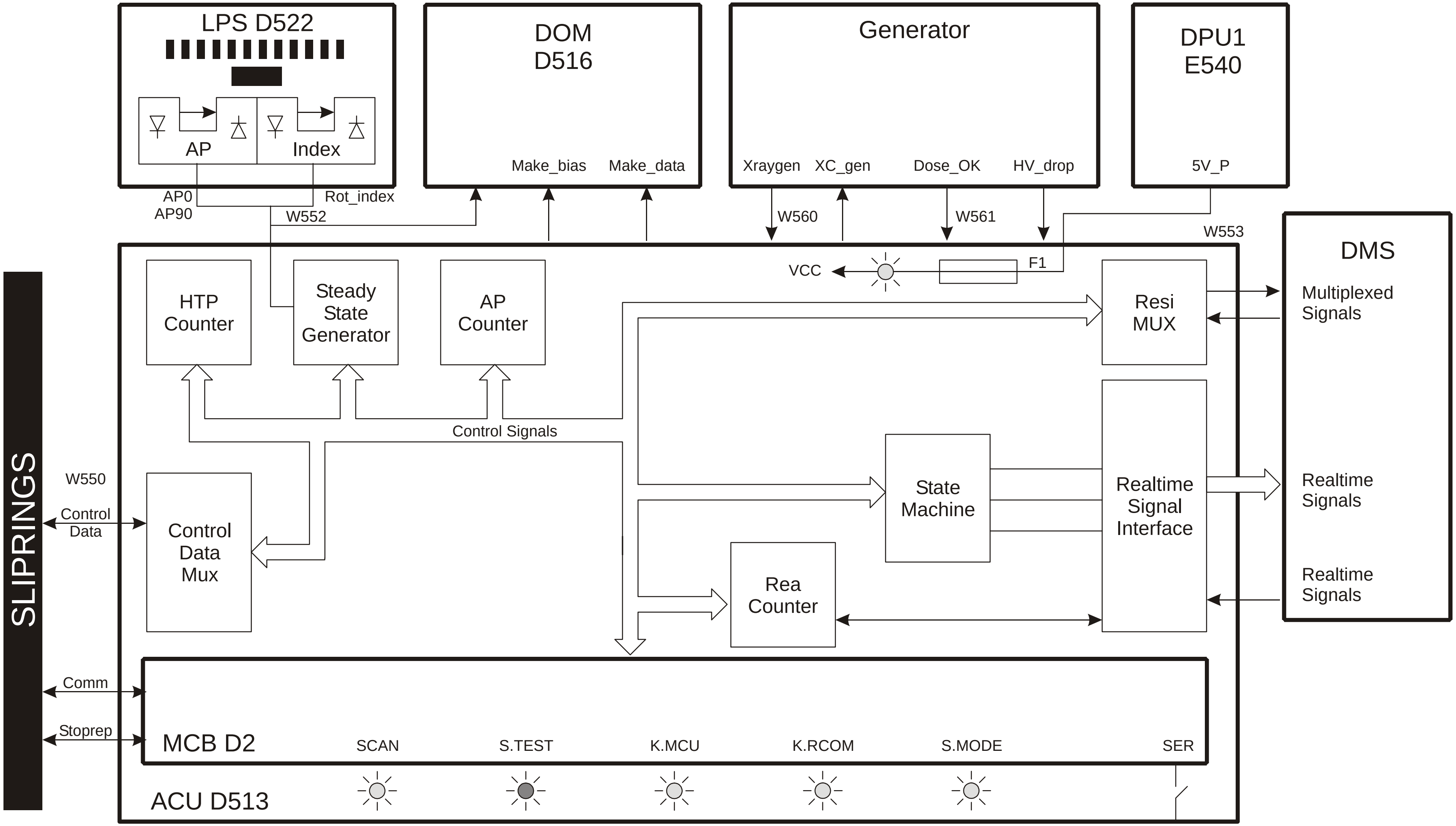

LPS D522
AP
Index
AP0
AP90
Rot_index
W552
DOM
D516
Make_bias
Make_data
Generator
Xraygen
XC_gen
Dose_OK
HV_drop
W560
W561
DPU1
E540
5V_P
W553
DMS
Multiplexed Signals
Realtime Signals
Realtime Signals
VCC
F1
HTP Counter
Steady State Generator
AP Counter
Resi MUX
Control Signals
State Machine
Realtime Signal Interface
Rea Counter
SLIPRINGS
W550
Control Data
Control Data Mux
Comm
Stopprep
MCB D2
SCAN
S.TEST
K.MCU
K.RCOM
S.MODE
SER
ACU D513

Figure 3-75: Acquisition Control 1 LEDs

Signals

Control Signals

Control signals connect the MCB with the different function blocks of the acquisition control.

AP0	The Angular Pulses 0 (**AP0**) are detected by a light barrier array on the D522 LPS, that generates 1160 **AP0** pulses per revolution.
AP90	The Angular Pulses 90 (**AP90**) are detected by a light barrier array on the D522 LPS, that generates 1160 **AP90** pulses per revolution. The are 90° phase-shifted to AP0.
Rot_index	The Rotation Index Pulse (**Rot_index**) is detected by a light barrier on the D522 LPS, that generates 1 **Rot_index** pulse per revolution.
Even_rea	Even Reading (**Even_rea**) is used to synchronize the focus deflection to the data acquisition timing.
Xray	High voltage is switched on in the generator.
XC_gen	X-ray Control Generator (**XC_gen**) switches on the high voltage in the generator.
Dose_OK	The signal **Dose_OK** is set from the generator some milliseconds after dose is detected at the Phi-monitor. It enables the Make_data signal to start the measurement.
HV_drop	High Voltage Drop (**HV_drop**) tells the Rcom that the X-ray signal, measured from the generator, has dropped below a certain limit (e.g., data are possibly corrupted).
VCC	Plus 5 V supplied from DPU1 via onboard fuse F1.

Multiplexed Signals

Multiplexed signals are used for the transmission of the FEE mode parameters and the multiplexed transmission of medium speed signals from ACU to Rcom and vice versa. The signal lines to the DMS are differential and optoisolated.

Real-time Signals

Real-time Signals are used for the transmission of fast speed signals from ACU to RCOM and vice versa. The signal lines to the DMS are differential and optoisolated

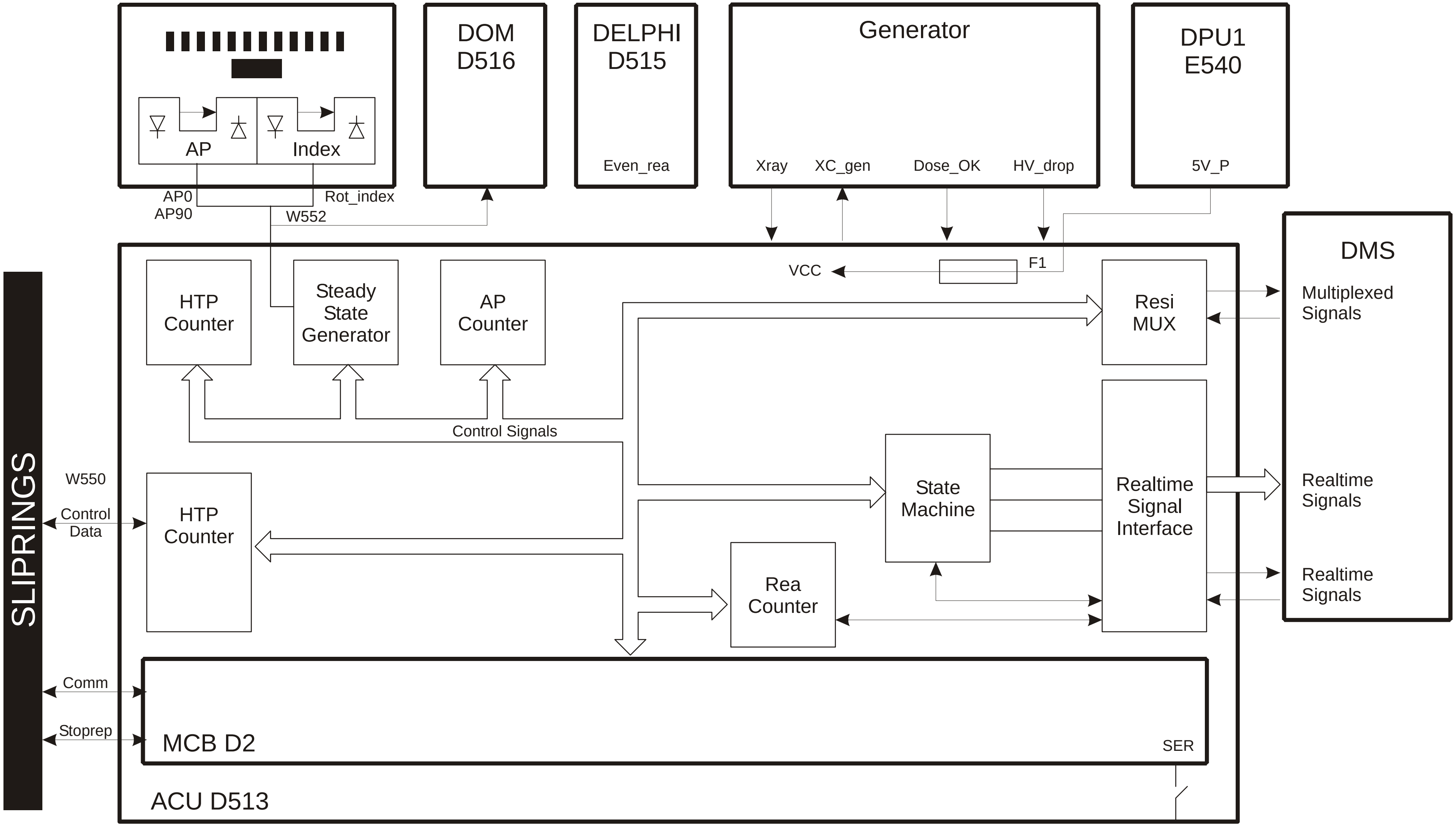

AP
Index
AP0
AP90
Rot_index
W552
DOM
D516
DELPHI
D515
Even_rea
Generator
Xray
XC_gen
Dose_OK
HV_drop
DPU1
E540
5V_P
VCC
F1
HTP
Counter
Steady
State
Generator
AP
Counter
Resi
MUX
DMS
Multiplexed
Signals
Control Signals
SLIPRINGS
W550
Control
Data
HTP
Counter
State
Machine
Realtime
Signal
Interface
Realtime
Signals
Realtime
Signals
Rea
Counter
Comm
Stoprep
MCB D2
SER
ACU D513

Figure 3-76: Acquisition Control 1 Signals

Acquisition Control 2

Signals

HTP	The Horizontal Table Pulse (**HTP**) is generated during horizontal table movement and is used to determine the table position. There is one pulse per 0.1mm of table movement.
Speed_OK	**Speed_OK** means that the rotation speed is within tolerance. It is not active during the stop, acceleration or brake phases.
XC_en	At Scan Start, X-ray Control Enable (**XC_en**) is sent to the Gantry Stationary to enable the generation of **XC_gen**.
Com_ok	Communication OK (**Com_OK**) tells the RCOM that the last sent data frame was recognized as valid by the receiver.
Ser_tx	To be explained later.
Ser_rx	To be explained later.
Recerr	Receiver Error (**Recerr**) is a parity error in the control data received from the Gantry Stationary.
Rcom_reset	**Rcom_reset** resets the Rcom Board during the RESET phase.
Make_data	**Make_data** tells the RCOM when to start data transmission, synchronized with the multiplied angular pulses and with the signal **Even_rea**.
Make_bias	**Make_bias** switches on bias (offset) measurement sequence inside the RCOM, usually activated during SCAN_LOAD, deactivated during SCAN_EXECUTE.
Rea_clk	One Reading Clock (**Rea_clk**) pulse is generated for every transmitted reading with measurement data. It is used for the reading counter.

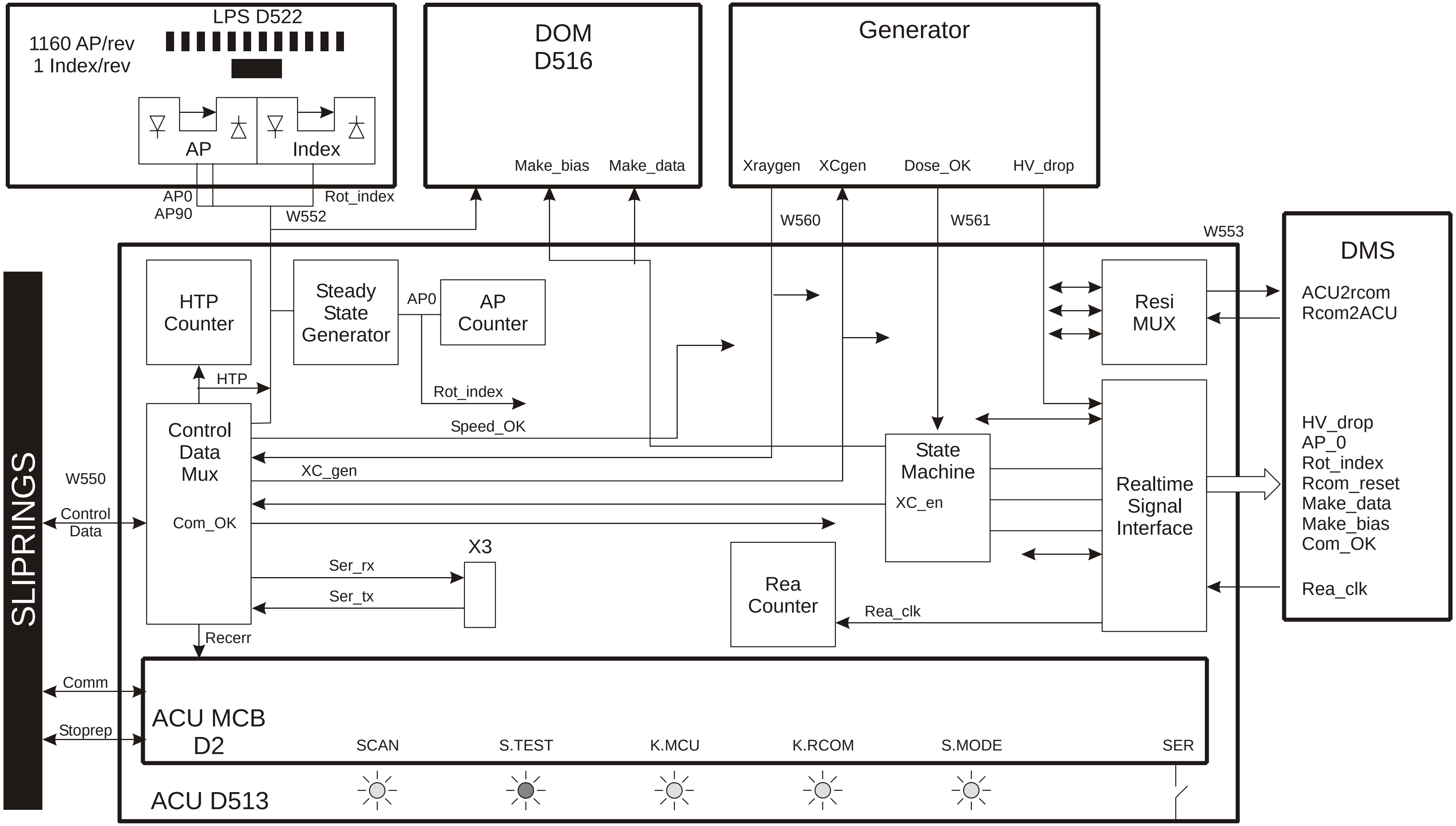

LPS D522
1160 AP/rev
1 Index/rev
AP
Index
AP0
AP90
Rot_index
W552
DOM
D516
Make_bias
Make_data
Generator
Xraygen
XCgen
Dose_OK
HV_drop
W560
W561
W553
DMS
ACU2rcom
Rcom2ACU
HV_drop
AP_0
Rot_index
Rcom_reset
Make_data
Make_bias
Com_OK
Rea_clk
SLIPRINGS
W550
Control
Data
Comm
Stoprep
HTP
Counter
HTP
Steady
State
Generator
AP0
AP
Counter
Rot_index
Speed_OK
Control
Data
Mux
XC_gen
Com_OK
Ser_rx
Ser_tx
X3
Recerr
Resi
MUX
State
Machine
XC_en
Realtime
Signal
Interface
Rea
Counter
Rea_clk
ACU MCB
D2
SCAN
S.TEST
K.MCU
K.RCOM
S.MODE
SER
ACU D513

Figure 3-77: Acquisition Control 2

Communication Channels

ACU2RCOM

Used for the transmission of the FEE mode parameters and the Multiplexed Transmission for medium speed signals from ACU to RCOM:

Table 3-23:

SIGNAL	INDICATION
HTP	Horizontal table pulses, counts the table position
XC_gen	Enables signal for X-ray
Xray	X-ray on indication
Par_reset	Partial reset of Rcom
Strobe	Handshake signal, data and address are valid
Read_write	Handshake signal, read/write from/to Rcom
HTP_up	HTP count direction (1=count up)
Speed_OK	Rotation speed in tolerance

RCOM2ACU

Use for the transmission of the FEE mode parameters and the multiplexed transmission for medium speed signals from RCOM to ACU:

Table 3-24:

SIGNAL	INDICATION
RCOM_OK	**RCOM WORKING AND COMMUNICATING WITH ACU**
ACK	**HANDSHAKE SIGNAL ACKNOWLEDGE TO STROBE SIGNAL**
REQUEST	**RCOM REQUESTS A READ OPERATION FROM ACU**
TEST_RUN	**ACTIVE DURING TEST, INACTIVE AT ALL OTHER TIMES**

Example for a rot-mode sequence with variable reading number:

1. SCAN LOADED received by the MCB via the CAN-bus.
2. START EXECUTE received by the MCB via the CAN-bus.
3. X-ray Control Enable (**XC_en**) sent to the Gantry stationary to enable radiation.
4. X-ray Control Generator (**XC_gen**) sent to the generator to switch radiation ON.
5. **Make_bias** deactivated to end the offset measurement.
6. **Dose_OK** set from the generator a few msec after dose is detected.
7. **Make_data** set and tells the RCOM to start the measurement.
8. Reading Clock (**Rea_clk**) generated and counted.
9. Angular Pulses (**AP**) counted until the nominal number is reached.
10. Make_data reset and tells the RCOM to stop the measurement.
11. X-ray Control Enable reset and sent to the Gantry station to disable radiation.
12. X-ray Control Generator (**XC_gen**) sent to the generator to switch radiation OFF.
13. **Make_bias** activated after 1 second.
14. SCAN EXECUTED sent from the MCB.

Power Supply

The Gantry Rotating has two AC supplies that are connected via the Power Slipring Assembly E420.

DPU1 and DPU2

Overview

The Digital Power Unit 1 (DPU 1) is a multiple power supply that generates the voltages shown in *Table 3-25*.

Table 3-25:

INPUT	VOLTAGE	INTERNAL VOLTAGE
48V_P	+38 VDC	DELPHI D515, ZCON D514 (only monitoring)
15V_N	-15 VDC	DELPHI D515, DOM D516, Phi_Amp D555, ZCON D514 (only monitoring)
15V_P	+15 VDC	DELPHI D515, DOM D516, Phi_Amp D555, ZCON D514 (only monitoring)
24V_P	+24 VDC	ZCON D514, DELPHI D515, DMS
5V_P	+5.4 VDC	ZCON D514, DELPHI D515, DOM D516, ACU D513
5V_P1	+5.4 VDC	Phi_Amp. D555; LPS, D522

The Digital Power Unit 2 (DPU2) is a multiple power supply that generates the voltages shown in *Table 3-26*:

Table 3-26:

INPUT	VOLTAGE	INTERNAL VOLTAGE
P24	+24 VDC	DMS, ZCON D514 (only monitoring)
N13	-13 VDC	DMS, ZCON D514 (only monitoring)
P8	+8 VDC	DMS, ZCON D514 (only monitoring)
P5	+5.5 VDC	DMS, ZCON D514 (only monitoring)

The mains supply for DPU2 is permanently on, even if the system is in off condition. The DMS is able to switch the DPU2 on and off during this time.

Signals and Test Points

L1_DPU1	The 230 V phase supply for Digital Power Unit 1 (DPU1), the generator and the oil pump of the tube cooling. The power is connected via sliprings from the Gantry Stationary
P24	A 24 VDC voltage from Digital Power Unit 2 (DPU2) connected to the C-Box backplane and the DMS.
N13	A minus 13 VDC voltage from Digital Power Unit 2 (DPU2) connected to the C-Box backplane and the DMS.
P8	An 8 VDC voltage from Digital Power Unit 2 (DPU2) connected to the C-Box backplane and the DMS.
P5	A 5.5 VDC voltage from Digital Power Unit 2 (DPU2) connected to the C-Box backplane and the DMS.
Power_disable_2	Switches the output voltage of DPU2 on and off. This is done depending on the DMS temperature, when the system is in off condition.
48V_P	A 38 VDC voltage from Digital Power Unit 1 (DPU1) connected to the C-Box backplane.
15C_N	A minus 15 VDC voltage from Digital Power Unit 1 (DPU1) connected to the C-Box.
15V_P	A 15 VDC voltage from Digital Power Unit 1 (DPU1) connected to the C-Box backplane.
24V_P	A 24 VDC voltage from Digital Power Unit 1 (DPU1) connected to the C-Box backplane and the DMS.
5V_P	A 5.4 VDC voltage from Digital Power Unit 1 (DPU1) connected to the C-Box backplane.
5V_P1	A 5.4 VDC voltage from Digital Power Unit 1 (DPU1) connected to the C-Box backplane. The difference to **5V_P** is an additional fuse in the DPU1 to protect boards without an internal fuse.

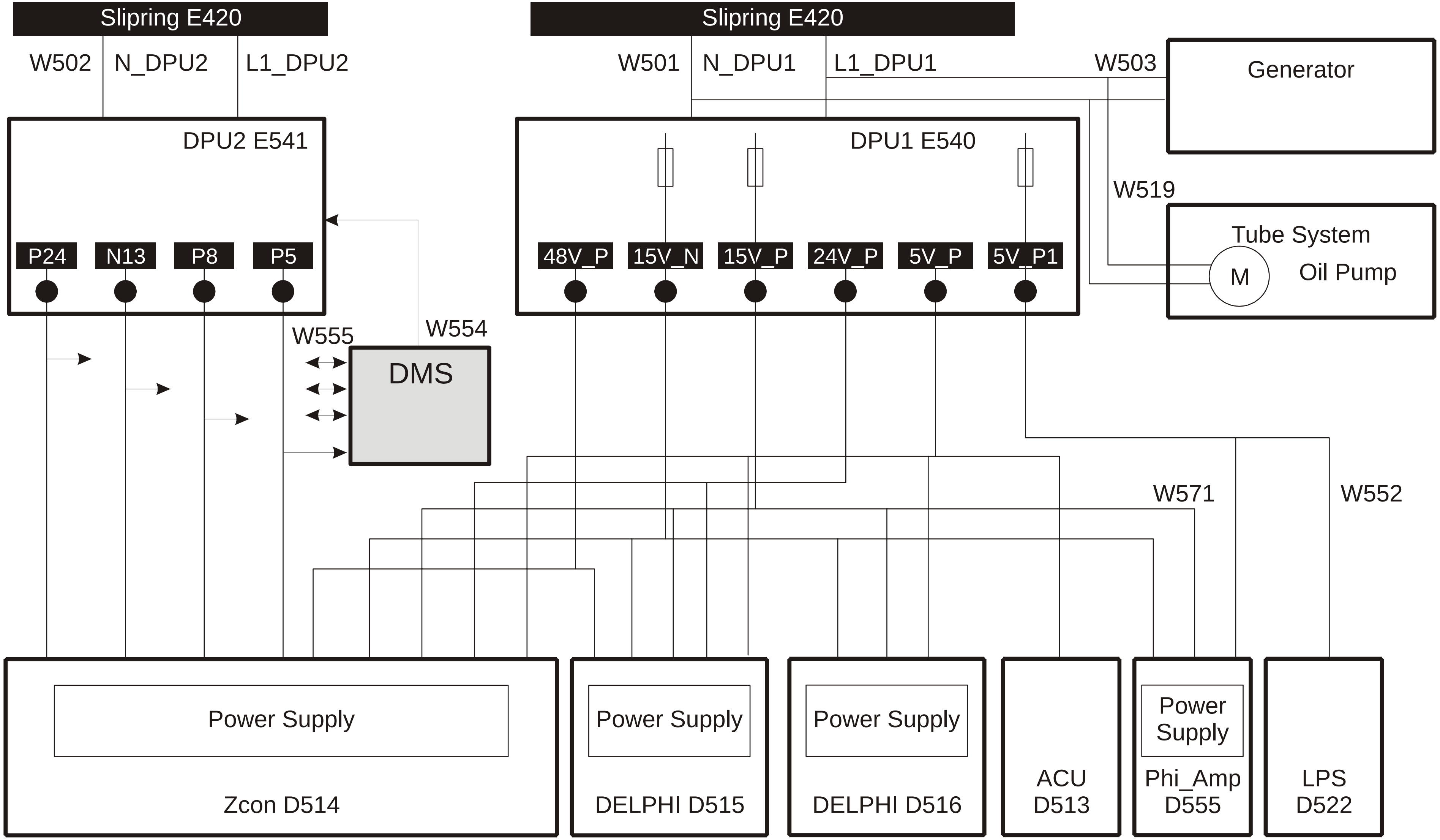

Slipring E420
W502
N_DPU2
L1_DPU2
DPU2 E541
P24
N13
P8
P5
W555
W554
DMS
Slipring E420
W501
N_DPU1
L1_DPU1
W503
Generator
DPU1 E540
W519
Tube System
M
Oil Pump
48V_P
15V_N
15V_P
24V_P
5V_P
5V_P1
W571
W552
Power Supply
Zcon D514
Power Supply
DELPHI D515
Power Supply
DELPHI D516
ACU
D513
Power
Supply
Phi_Amp
D555
LPS
D522

Figure 3-78: Power Supply—Test Points

Power Supply ZCON

Overview

There are onboard fuses for two voltages: P_24V and VCC.

All voltages from DPU1 and DPU2, except **5V_P**, are monitored on MCB D2 and generate one bit of **Volt_OK**. **5V_P** is connected to MCB D2.

Signals

Voltage OK (Volt_OK)

The following voltages are monitored:

Table 3-27:

INPUT	VOLTAGE	TOLERANCE	POWER SUPPLY	INTERNAL VOLTAGE
P24	+24 V	Fuse monitoring	DPU2, E541	only monitored
N13	-13 V	Fuse monitoring	DPU2, E541	only monitored
P8	+8 V	Fuse monitoring	DPU2, E541	only monitored
P5	+5.5 V	Fuse monitoring	DPU2, E541	only monitored
48V_P	+38 V	Fuse monitoring	DPU1, E540	only monitored
15V_N	-15 V	Fuse monitoring	DPU1, E540	only monitored
15V_P	+15 V	Fuse monitoring	DPU1, E540	only monitored
24V_P	+24 V	Fuse monitoring	DPU1, E540	P_24V, Pwr24
5V_P	+5.4 V	monitored on MCB, D2		VCC

Pwr24 The power supply for the driver and stepping motors is 24 VDC that is supplied by the Digital Power Unit 1 (DPU1). The 24 V are controlled by the MCB processor with the signal MPE (Motor Power Enable).

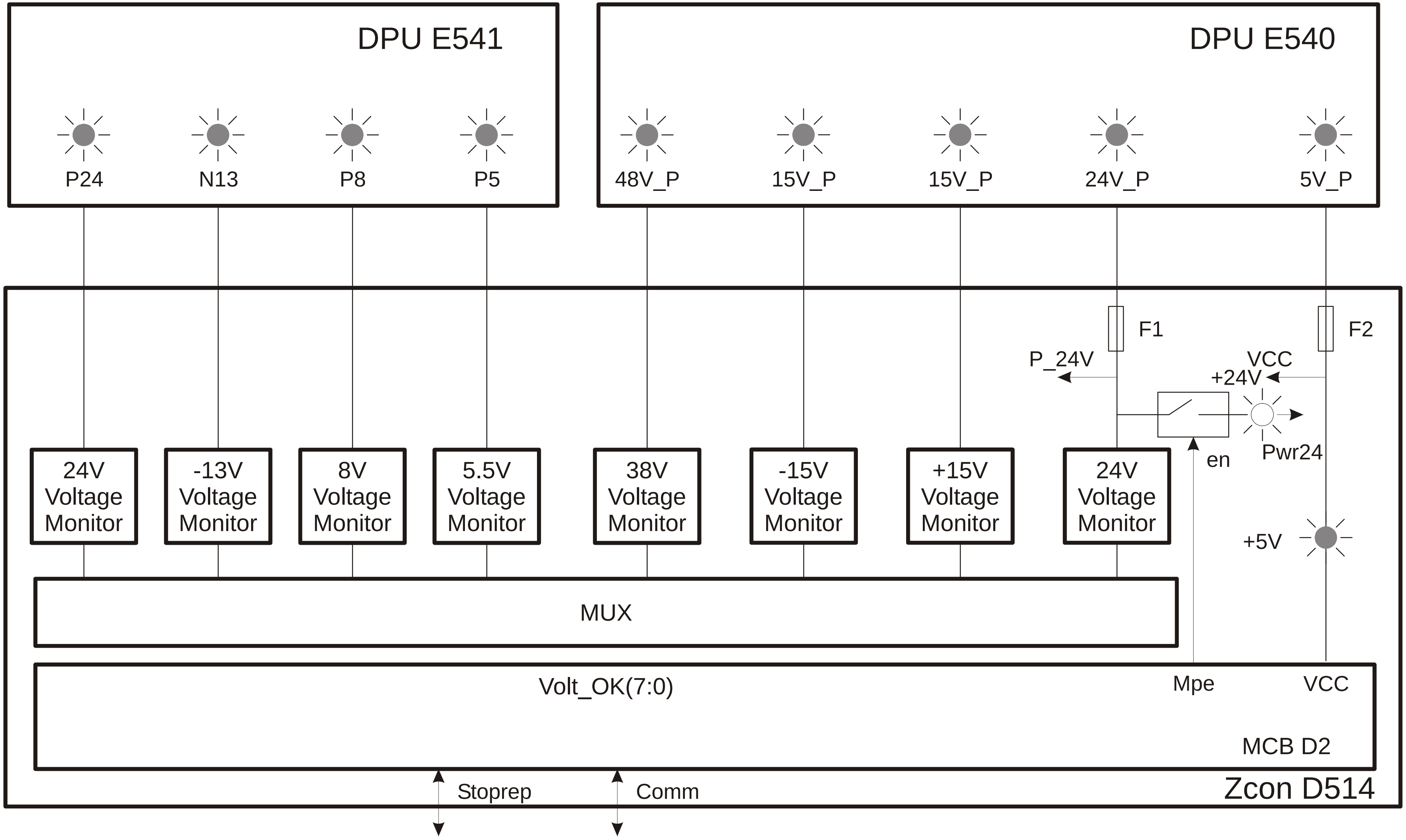

DPU E541
P24
N13
P8
P5
DPU E540
48V_P
15V_P
15V_P
24V_P
5V_P
F1
F2
P_24V
VCC
+24V
en
Pwr24
24V Voltage Monitor
-13V Voltage Monitor
8V Voltage Monitor
5.5V Voltage Monitor
38V Voltage Monitor
-15V Voltage Monitor
+15V Voltage Monitor
24V Voltage Monitor
+5V
MUX
Volt_OK(7:0)
Mpe
VCC
MCB D2
Stoprep
Comm
Zcon D514

Figure 3-79: Z_CON Power Supply

Power Supply DELPHI and DOM

Overview

DELPHI There are onboard fuses on DELPHI D515 for three voltages: VCC3, P_24V and VCC.

DOM There are onboard fuses on DOM D516 for three voltages: N_15V, P_15V and VCC.

Signals

VCC2 VCC2 is derived via a filter from P_24V.

PownotOK

The error Power Not OK (PownotOK) is generated if the voltage monitoring on DELPHI D515 shows an error. An error message is issued and the deflection is disabled. The following voltages are monitored:

Table 3-28:

INPUT	VOLTAGE	TOLERANCE	POWER SUPPLY	INTERNAL VOLTAGE
48V_P	+238 V	Fuse monitoring	DPU1	VCC3
15V_N	-15 V	Fuse monitoring	DPU1	N_15V
15V-P	+15 V	Fuse monitoring	DPU1	P_15V
24V_P	+24 V	Fuse monitoring	DPU1	P_24V
5V_P	+5.4 V	Monitored on MCB, D2		

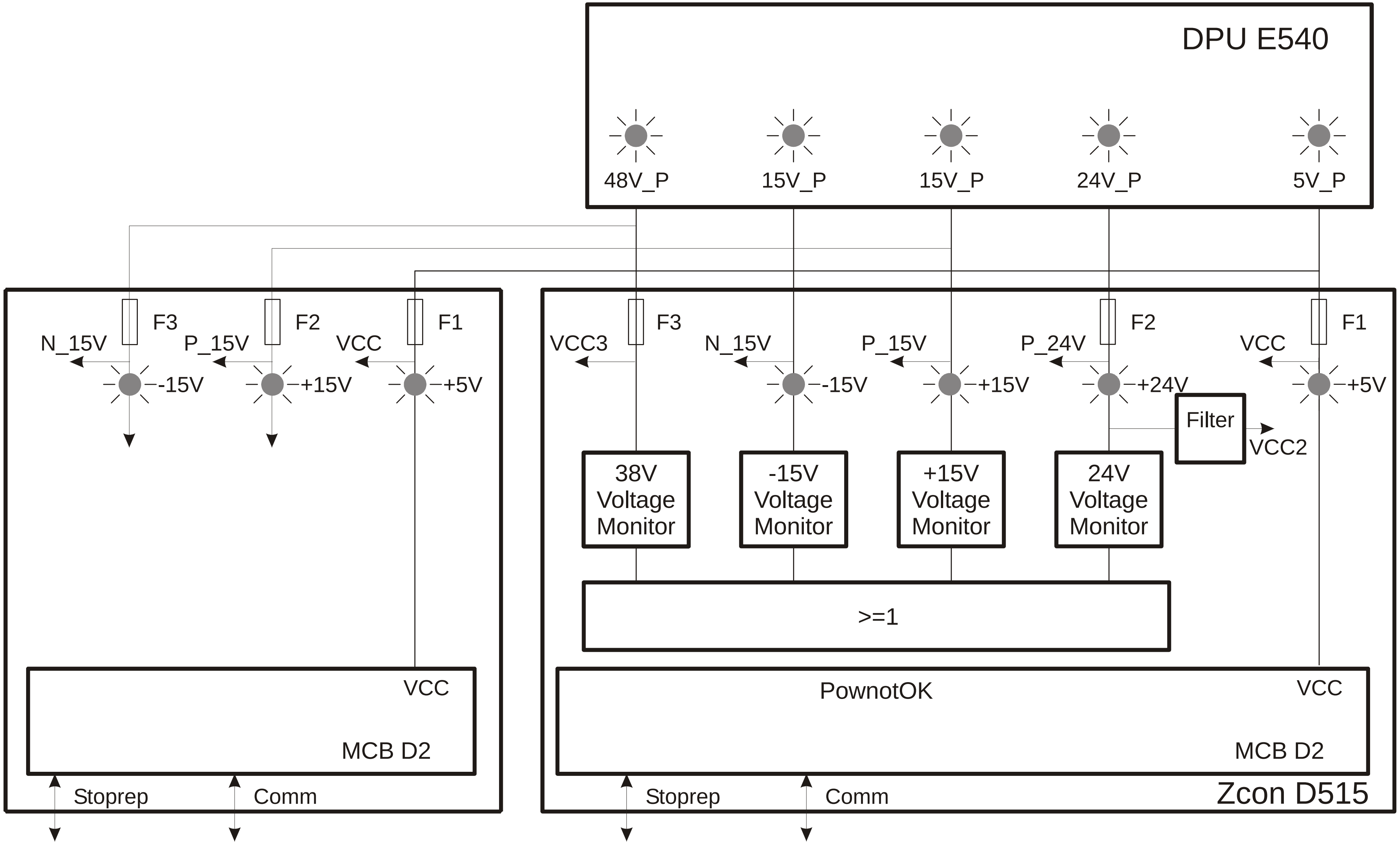

DPU E540
48V_P
15V_P
15V_P
24V_P
5V_P
F3
F2
F1
N_15V
P_15V
VCC
-15V
+15V
+5V
VCC
MCB D2
Stoprep
Comm
F3
F2
F1
VCC3
N_15V
P_15V
P_24V
VCC
-15V
+15V
+24V
+5V
Filter
VCC2
38V Voltage Monitor
-15V Voltage Monitor
+15V Voltage Monitor
24V Voltage Monitor
>=1
PownotOK
VCC
MCB D2
Zcon D515
Stoprep
Comm

Figure 3-80: Power Supply

Power Supply Tube Collimator Box

The components listed in this section receive power from DPU1.

Phi_Amp The Phi Amplifier (Phi_Amp) Board is divided into two parts:

- The Z-Pre-amplifier part is supplied with +5 V, -15 V and +15 V from the DPU1 power supply.
- The Phi-pre-amplifier part is supplied with +5 V, -15 V and +15 V from the DPU1 power supply.

Limit switches

The Optical Limit Switches inside the Tube Collimator Box are supplied with 5 V from the DPU1 power supply.

Encoder The Optical Encoders inside the Tube Collimator Box are supplied with 5 V from the DPU1 power supply.

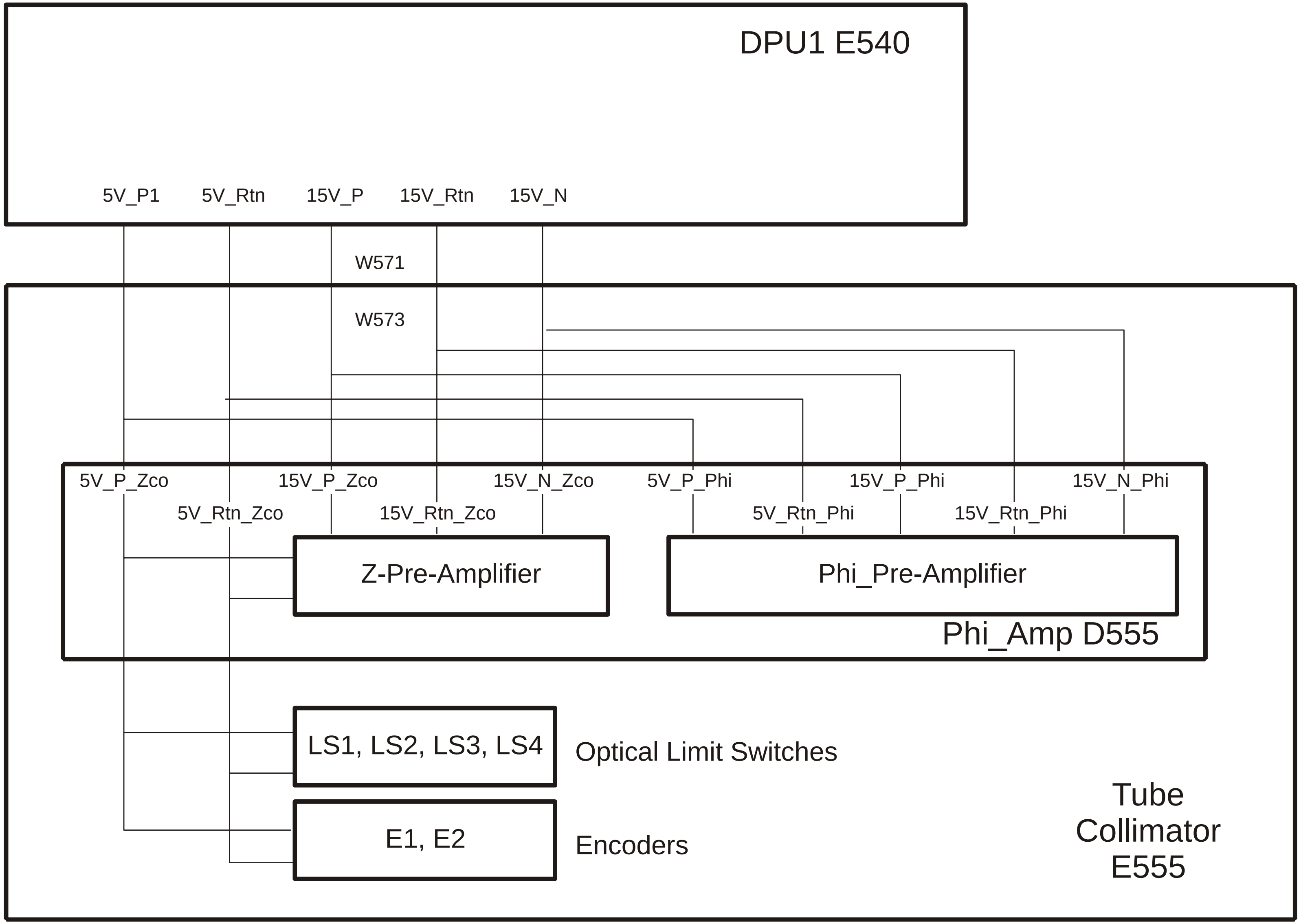

DPU1 E540
5V_P1
5V_Rtn
15V_P
15V_Rtn
15V_N
W571
W573
5V_P_Zco
5V_Rtn_Zco
15V_P_Zco
15V_Rtn_Zco
15V_N_Zco
5V_P_Phi
5V_Rtn_Phi
15V_P_Phi
15V_Rtn_Phi
15V_N_Phi
Z-Pre-Amplifier
Phi_Pre-Amplifier
Phi_Amp D555
LS1, LS2, LS3, LS4
Optical Limit Switches
E1, E2
Encoders
Tube
Collimator
E555

Figure 3-81: Power Supply - Tube Collimator Box

Slip Ring Troubleshooting

Inhomogeneity and Damages to the Polyurethane (PU)

Rough Surface scattered with Bubbles

At non-treated areas of the plastic mold, a rough surface with scattered bubbles may appear. This is acceptable without any further specification.

Air Inclusions

Air inclusions (pockets or cavities)as shown in *Figure 3-82* are acceptable, as long as the inclusions are not at functional areas like between tracks.There is no definition for number or size of air inclusions per slipring.

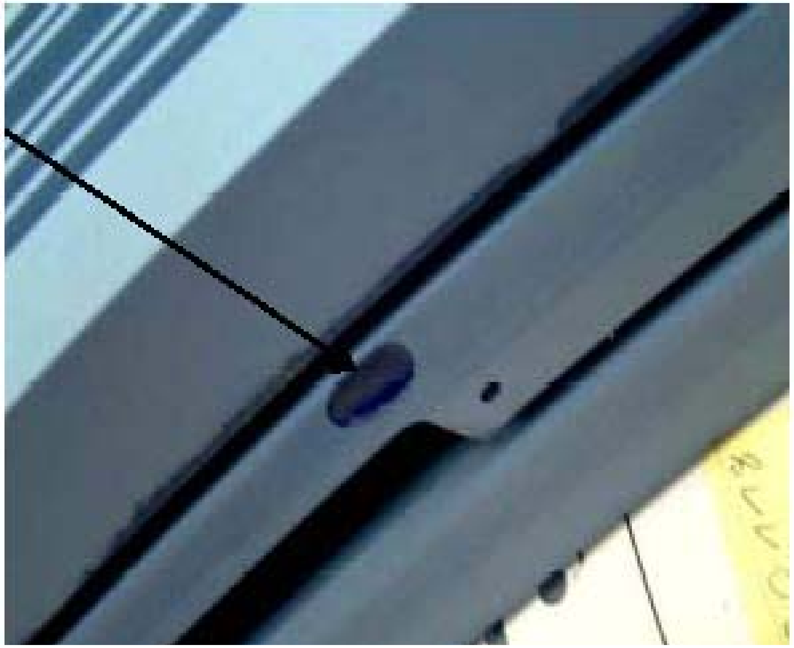


Figure 3-82: Air Inclusion

Scratches on the PU

Scratches or little damages on PU in non-functional areas as shown in *Figure 3-83* and *Figure 3-84* are acceptable without any further specification.

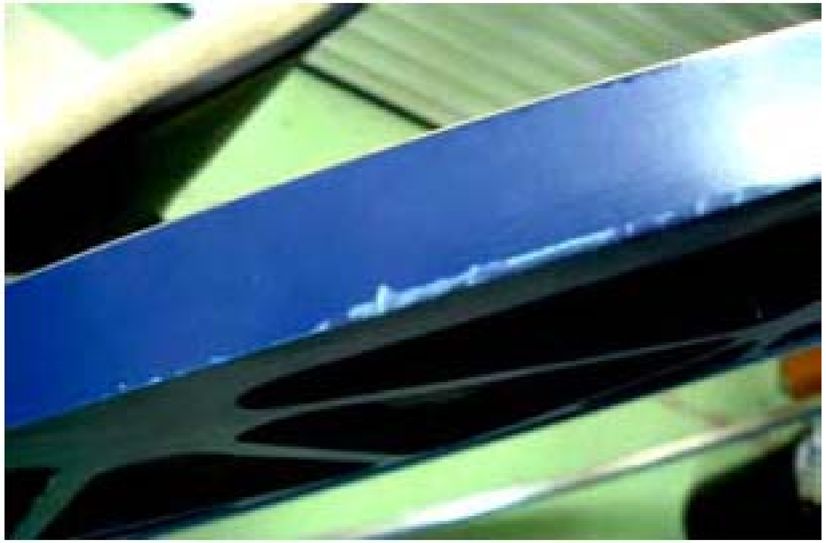


Figure 3-83: Scratches on the PU

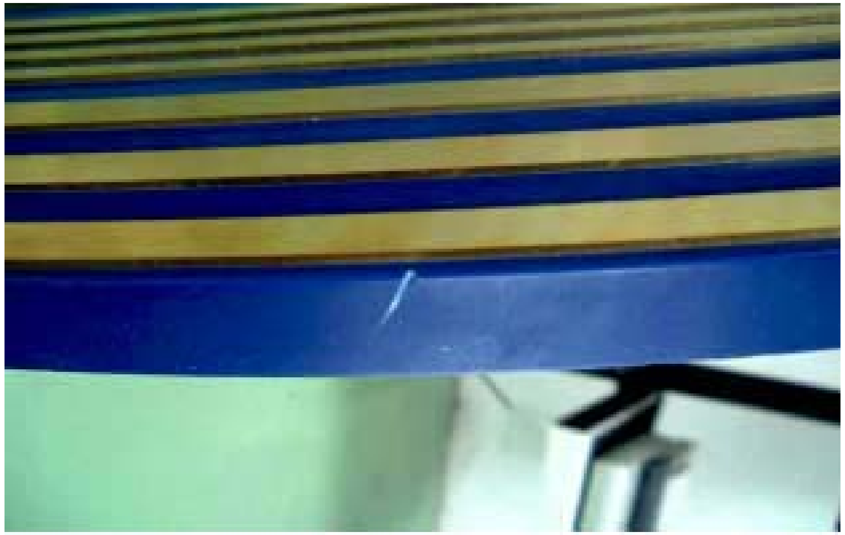


Figure 3-84: Scratches on the PU

Reworked Areas

Reworked areas repaired with polyurethane “resin” can be easily recognized because the color of the repair kit material is a little bit brighter in blue. In case of bigger damages at mechanically non-stress areas, the PU material around the defect can be replaced by glueing in a PU block as shown in *Figure 3-85*.

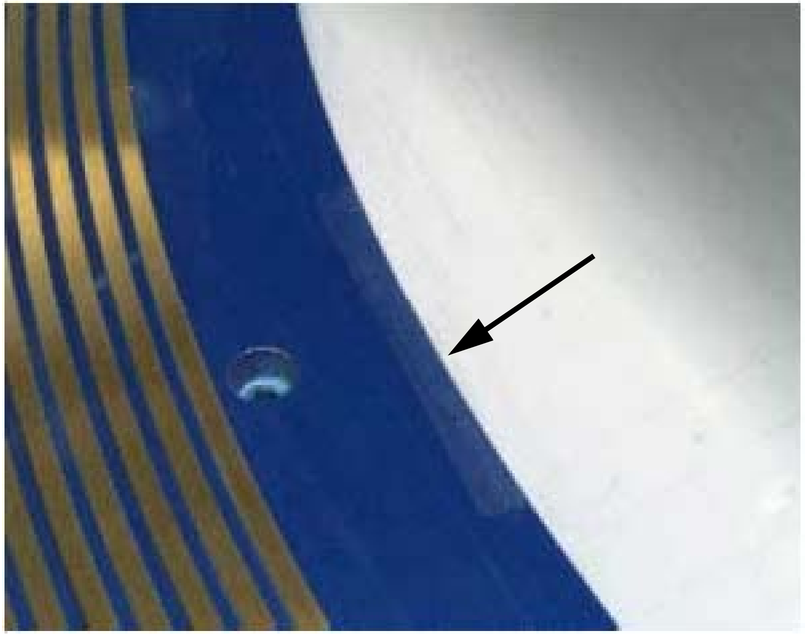


Figure 3-85: Reworked PU Block

Track Surface

According to the design and with respect to the lifetime cycles of the brushes, a track surface has to verify a roughness rectangular to the running-direction of 4,5 ±1,5µm. This roughness is generated and verified by a controlled and validated lathe process.

Despite this fact the surface may show the following differences:

Shadows

Due to corn-size and orientation during metallurgic processes in melting/casting tracks, some “shadows”may appear after surface finish (see *Figure 3-86*). These shadows are cosmetic issues and do not harm functional features in any way (i.e., they are acceptable).

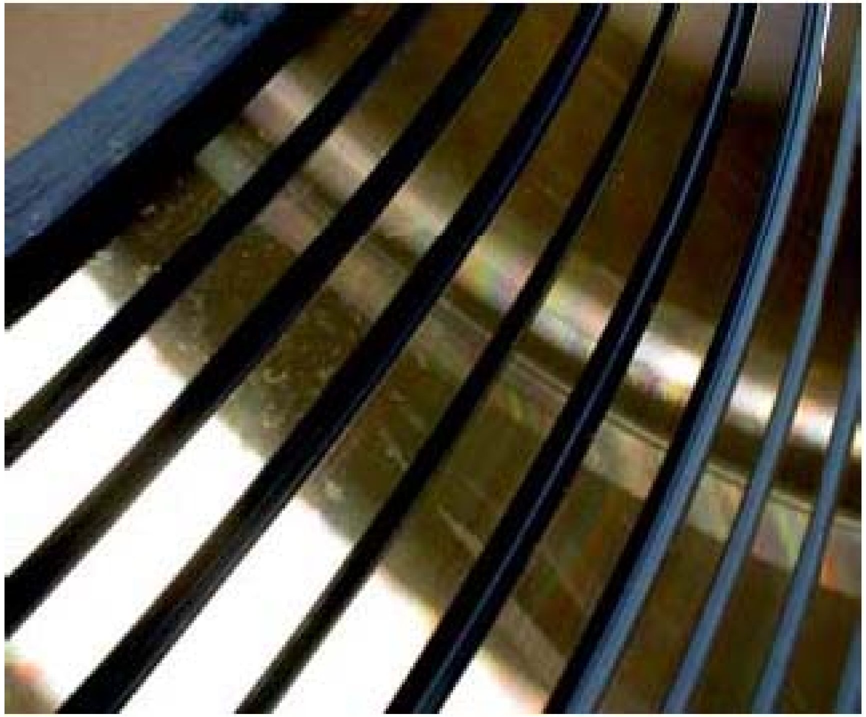


Figure 3-86:

Pollution on Tracks

For some reason, it is possile that some dash of glue or other materials remain on the track surface (see *Figure 3-87*). This pollution has to be reworked as shown in *Figure 3-87*.

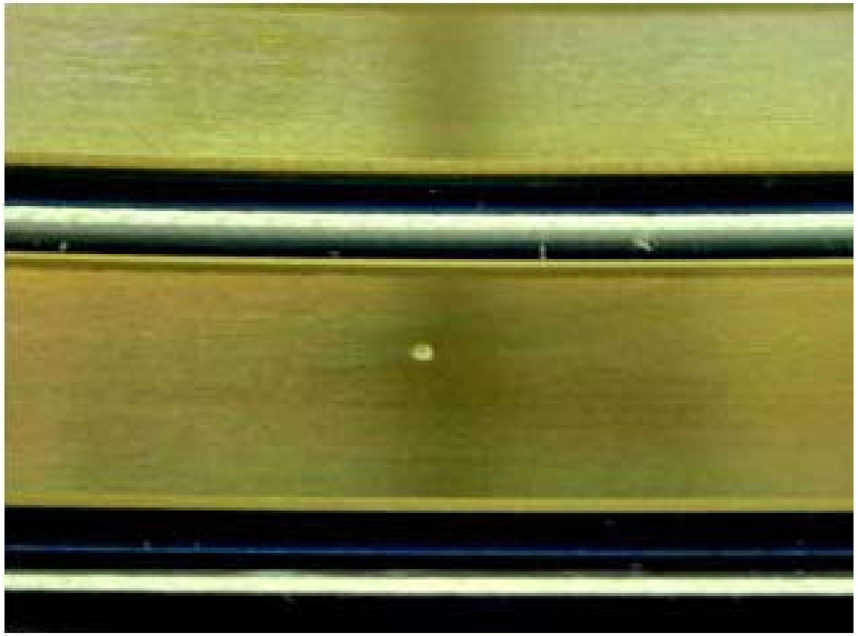


Figure 3-87:

Rework Instruction for Pollution on Tracks

1. Wrap paper around a wooden stick as shown in *Figure 3-88* (use a normal cleaning paper with a flat wooden stick- 200 mm long and the same width as the track).
2. Rub the stick in 30° angle over the debris (you can press on the track as hard as you can) until the track is clean.

NOTE:

There is no danger of damage to the track surface from the wooden stick.

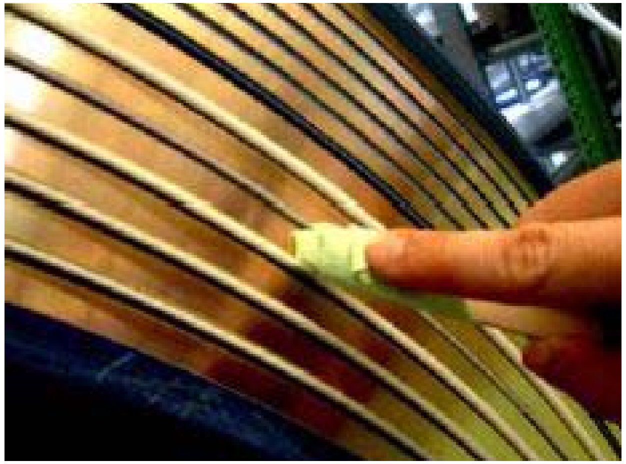


Figure 3-88: Cleaning the Slip Ring

Micro Spots

Also due to the reasons mentioned in Section *“Shadows”*, some micro spots may appear. They are acceptable unless they do not exceed the following specifications in *Figure 3-89*.

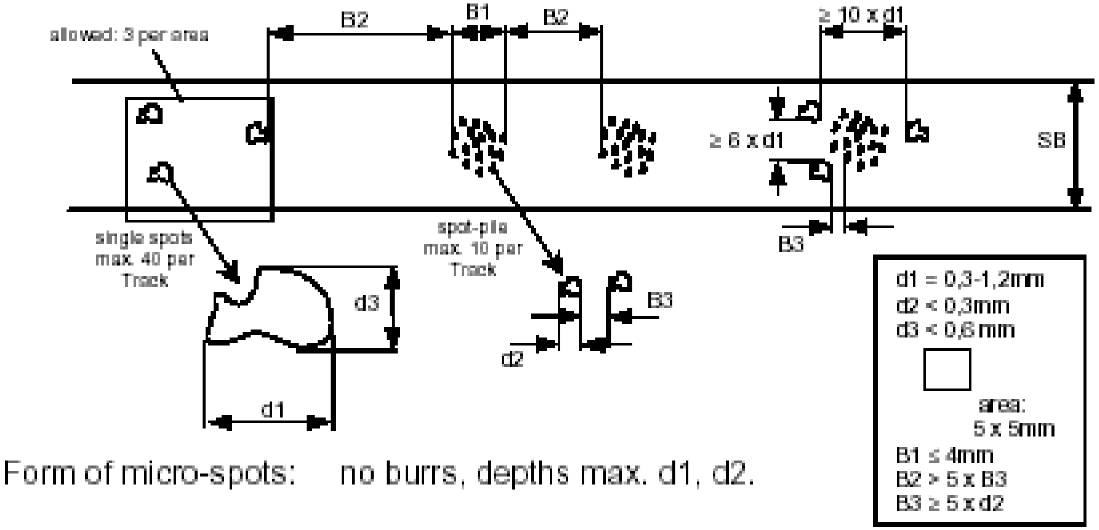

allowed: 3 per area
B2
B1
B2
≥ 10 x d1
≥ 6 x d1
SB
B3
single spots
max. 40 per
Track
spot-pile
max. 10 per
Track
d3
B3
d2
d1
Form of micro-spots: no burrs, depths max. d1, d2.
d1 = 0,3-1,2mm
d2 < 0,3mm
d3 < 0,6 mm
area:
5 x 5mm
B1 ≤ 4mm
B2 > 5 x B3
B3 ≥ 5 x d2

Figure 3-89:

Further Possible Defects

Conductive Material

Debris of conductive material,e.g.little copper spirals from the lathe process, is not allowed on the slip ring body, especially between the tracks.

If some loose material, or material that just is just adhered, is detected it must be carefully removed.

Surface Finish

All metal piece parts are chromatized to protect surfaces against oxidation. The finished surface may vary visually in its color. Color variations are absolutely normal. The surface finish shall cover the complete surface of all parts.

A complaint criterion is a non treated area of at least 2mm x 3mm expanse.

Threaded Inserts

All threaded inserts must be inserted completely. Any remaining length outside the parts surface is not allowed.

Gantry Rotating Parts Replacement

Overview

This section deals with the Gantry Rotating Replacement Parts.

The following figure show the location of the parts being replaced.

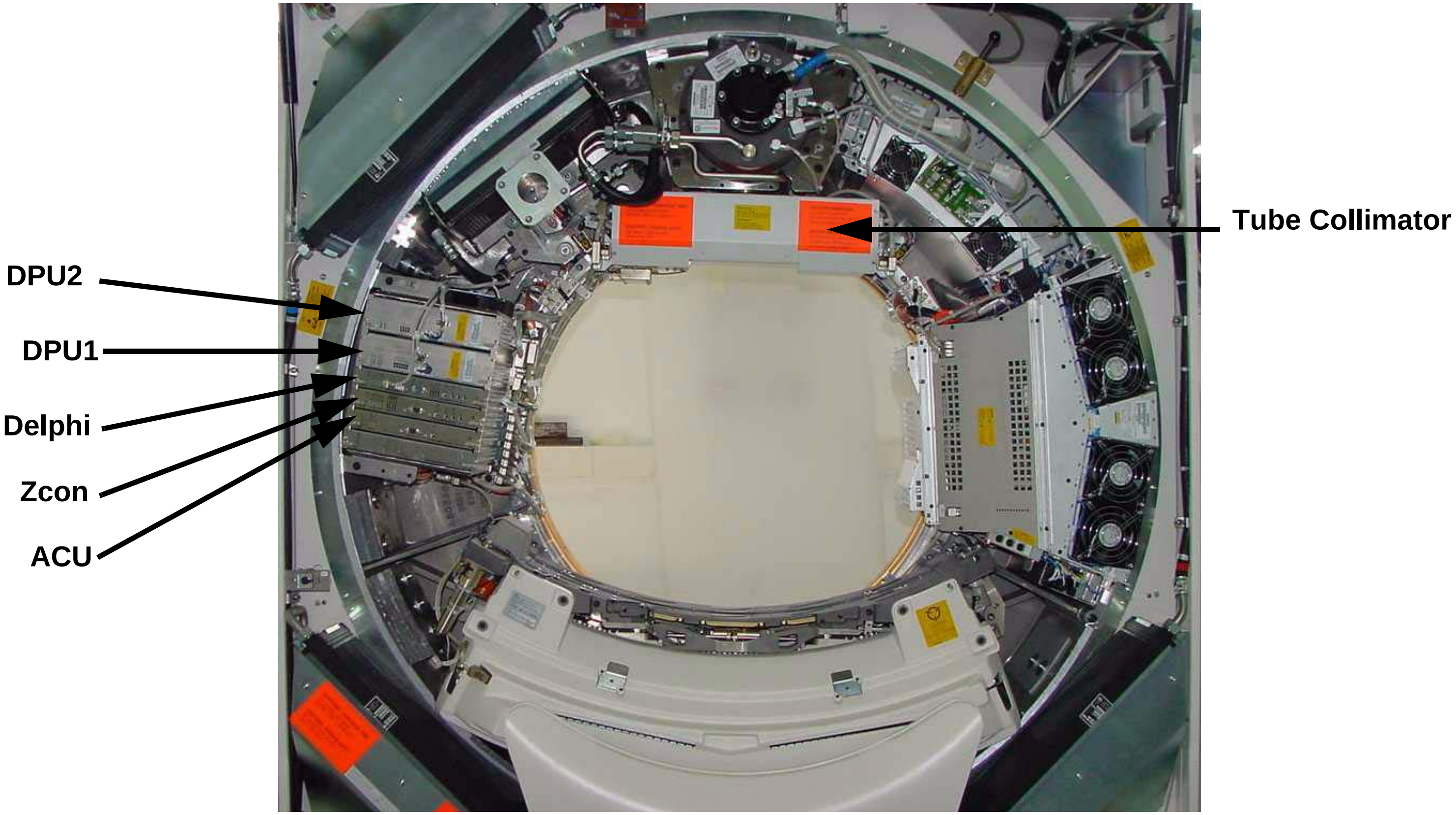

Tube Collimator
DPU2
DPU1
Delphi
Zcon
ACU

Figure 3-90:

Replacing the Tube Collimator (E555)

Read these instructions completely before starting.

No special tools are required for this procedure.

Preparations

Prepare to replace the tube collimator assembly as follows:

1. Move the couch to its outer and lowest position.
2. Loosen the two screws on the gantry front cover, remove the Plexiglas ring and open the front cover.

WARNING

TURN THE SWITCH ‘S301’ TO THE OFF POSITION.

WARNING

BEFORE PERFORMING THE WORK, TURN THE GANTRY OFF FROM THE CT-BOX.

3. Rotate the gantry by hand until the tube collimator assembly is in the 12 o’clock position.
4. Secure the rotating part of the Gantry with the locking pin.

WARNING

DO NOT BEGIN WORKING ON THE ROTATING PART OF THE GANTRY UNTIL THE PROTECTIVE CONDUCTOR BETWEEN THE STATIONARY AND ROTATING PARTS OF THE GANTRY IS CONNECTED. (THE PROTECTIVE CONDUCTOR IS INCLUDED IN THE SERVICE TOOLS KIT.)

The Tube Collimator Removal

Remove the old tube collimator as follows (see *Figure 3-91*):

1. Disconnect the following cables:
    - Cable at connector X552, on the right
    - Cable at connector X553, on the right
    - Cable at connector X554, on the left
    - Cable at connector X555, on the left
    - Ground connection
    - Cables from the reference amplifier

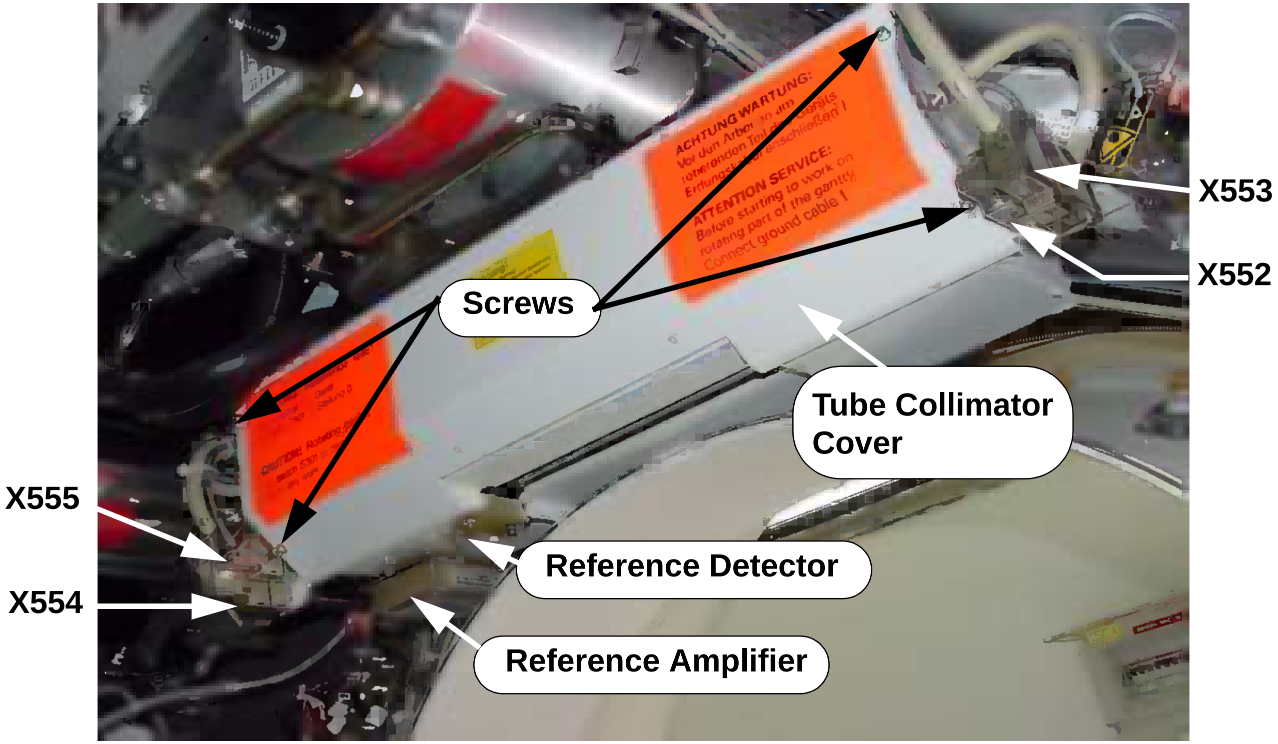

X553
X552
Screws
Tube Collimator Cover
X555
X554
Reference Detector
Reference Amplifier

Figure 3-91: The Tube Collimator Assembly

2. Remove the four 8 mm Allen screws on the back of the assembly.
3. Remove the collimator from the Gantry.
4. Remove two nuts holding the Reference Detector, the three nuts that secure the Reference Amplifier and remove them from the old Tube Collimator (see *Figure 3-92*).

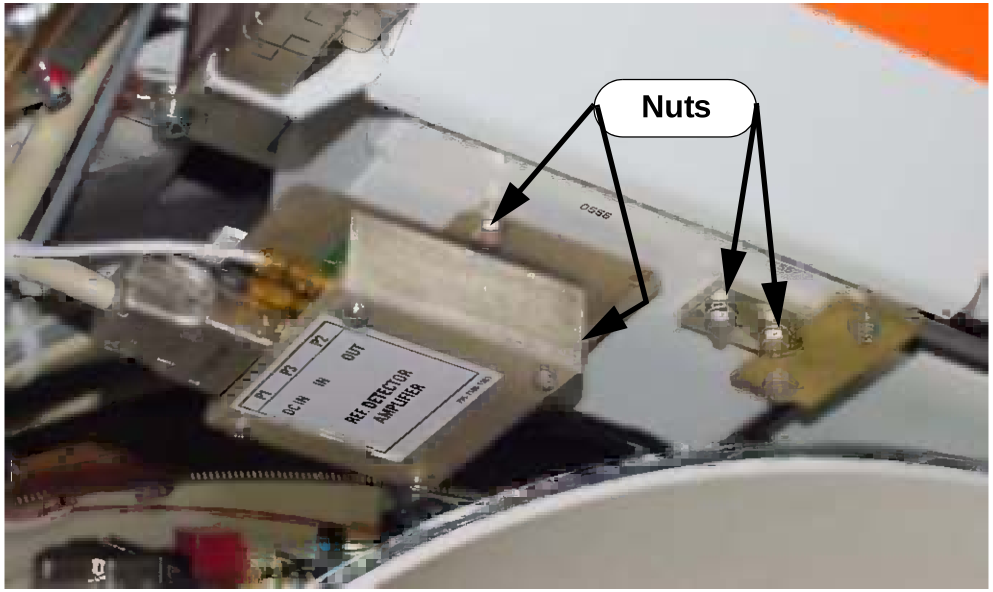


Figure 3-92: The Reference Detector and Amplifier

Tube Collimator Installation

Install the new Tube Collimator one as follows:

1. Install the Reference Detector and the Reference Amplifier on the new Tube Collimator.
2. Insert the new Tube Collimator in the place.
3. Tighten the four 8 mm Allen screws with a torque of 90 Nm.
4. Connect the following cables:
   - Cable at connector X552, on the right
   - Cable at connector X553, on the right
   - Cable at connector X554, on the left
   - Cable at connector X555, on the left

  - Ground connection
  - Cables from the reference amplifier
5. Secure all cables with cable ties.

Final Steps

1. Release the rotor locking pin.
2. Turn the Gantry ON from the CT-Box.
3. Turn the switch ‘S301’ to the ON position.
4. Load the two calibration parameters to 'ZCON' controller, from the floppy disk, delivered with the new Tube Collimator.
5. Make some scans in different modes to ensure proper functioning of the newly installed Tube Collimator.
6. Conduct Z-alignment adjustment, calibrations and measurements according to the Physic file, delivered with the system.
7. Close the Gantry front cover, install the Plexiglas ring and tighten the two screws in the lower part of the front cover.

Replacing the PHI_Amp (D555) Board

Read these instructions completely before starting.

No special tools are required for this procedure.

Preparations

Prepare to replace the tube collimator assembly as follows:

1. Move the couch to its outer and lowest position.
2. loosen the two screws on the gantry front cover, remove the Plexiglas ring and open the front cover.

⚠ **WARNING**

TURN THE SWITCH ‘S301’ TO THE OFF POSITION.

⚠ **WARNING**

BEFORE PERFORMING THE WORK, TURN THE GANTRY OFF FROM THE CT-BOX.

3. Rotate the gantry by hand until the tube collimator assembly is in the 12 o’clock position.
4. Secure the rotating part of the Gantry with the safety bolt.

⚠ **WARNING**

DO NOT BEGIN WORKING ON THE ROTATING PART OF THE GANTRY UNTIL THE PROTECTIVE CONDUCTOR BETWEEN THE STATIONARY AND ROTATING PARTS OF THE GANTRY IS CONNECTED. (THE PROTECTIVE CONDUCTOR IS INCLUDED IN THE SERVICE TOOLS KIT.)

PHI_Amp Board Removal

Remove the old PHI_Amp (D555) board as follows:

1. Loosen the four Allen screws, shown in *Figure 3-93*, and open the collimator cover.
2. Disconnect the following cables:

> **NOTE:**
>
> Mark cables prior to disconnecting.

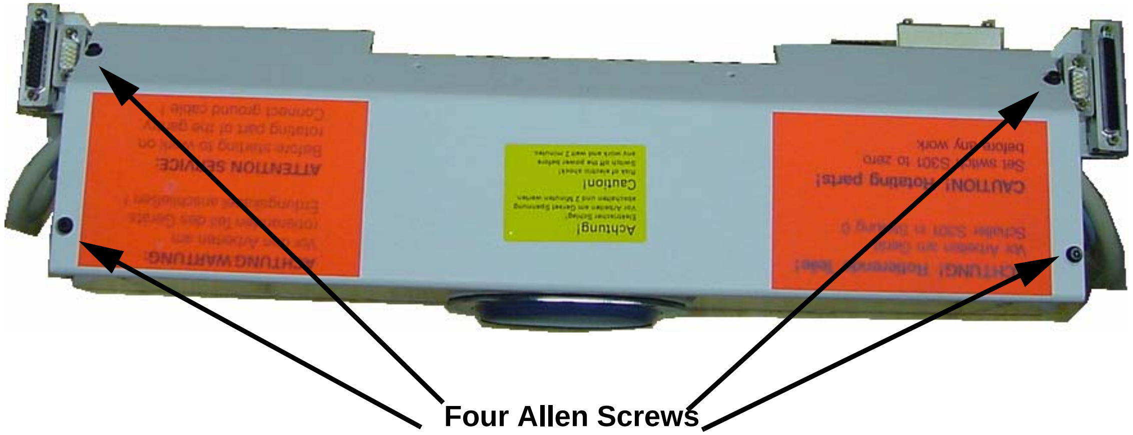


Figure 3-93: Four Allen Screws to be Removed

   - Ground cable at X1
   - Cable E555.D555 at X5
   - Cable E555.D555 at X8
   - Cable at X3, X4, X6, X9, X21, and X22 contacts
3. Remove the five 7 mm mounting screws.
4. Remove the PHI_Amp (D555) board.

PHI_Amp Board Installation

1. Install the new board and tighten the five screws.
2. Connect the following cables:
   - Ground cable at X1

   - Cable E555.D555 at X5
   - Cable E555.D555 at X8
   - Cable at X3, X4, X6, X9, X21, and X22 contacts
3. Secure all cables with cable ties.
4. Close the collimator cover and tighten the four screws

Final Steps

1. Release the rotor safety bolt.
2. Turn the Gantry ON from the CT-Box
3. Turn the switch ‘S301’ to the ON position.
4. Make some scans in different modes to ensure proper system functioning.
5. Conduct Z-alignment adjustment, calibrations and measurements according to the Physic file delivered with the system.
6. Close the Gantry front cover, install the Plexiglas ring and tighten the two screws in the lower part of the front cover.

Replacing the PHI_Z_MON (D554) Board

Read these instructions completely before starting.

No special tools are required for this procedure.

Preparations

Prepare to replace the tube collimator assembly as follows:

1. Move the couch to its outer and lowest position.
2. loosen the two screws on the gantry front cover, remove the Plexiglas ring and open the front cover.

⚠ **WARNING**

TURN SWITCH 'S301' TO THE OFF POSITION.

⚠ **WARNING**

BEFORE PERFORMING THE WORK, TURN THE GANTRY OFF FROM THE CT-BOX.

3. Rotate the gantry by hand until the tube collimator assembly is in the 12 o'clock position.
4. Secure the rotating part of the Gantry with the safety bolt.

⚠ **WARNING**

DO NOT BEGIN WORKING ON THE ROTATING PART OF THE GANTRY UNTIL THE PROTECTIVE CONDUCTOR BETWEEN THE STATIONARY AND ROTATING PARTS OF THE GANTRY IS CONNECTED. (THE PROTECTIVE CONDUCTOR IS INCLUDED IN THE SERVICE TOOLS KIT.)

PHI_Z_Mon Board Removal

Remove the old PHI_Z_Mon (D555) board as follows:

1. Loosen the four Allen screws, shown in *Figure 3-93* and open the collimator cover.
2. Disconnect the following cables:

NOTE:

Mark cables prior to disconnecting.

   - Ground cable at X1
   - cable E555.D555 at X5
   - cable E555.D555 at X8
   - cable at X3, X4, X6, X9, X21, and X22 contacts.
3. Remove the five 7 mm mounting screws**.**
4. Remove the PHI_Z_Mon (D555) board.
5. Remove the complete collimator mechanics.

NOTE:

Be careful not to damage any parts with the tools.

6. Remove the PHI_Z_Mon board.

PHI_Z_Mon Board Installation

1. Install the PHI_Z_Mon board.
2. Install the complete collimator mechanics.
3. Install the new board and tighten the five screws.
4. Connect the following cables:
    - Ground cable at X1
    - Cable E555.D555 at X5
    - Cable E555.D555 at X8
    - Cable at X3, X4, X6, X9, X21, and X22 contacts
5. Secure all cables with cable ties.
6. Close the collimator cover and tighten the four screws

Final Steps

1. Release the rotor safety bolt.
2. Turn the Gantry ON from the CT-Box
3. Turn the switch ‘S301’ to the ON position.
4. Make some scans in different modes to be sure that the system functions properly.
5. Conduct Z-alignment adjustment, calibrations and measurements according to the Physic file delivered with the system.
6. Close the Gantry front cover, install the Plexiglas ring and tighten the two screws in the lower part of the front cover.
7. Remove the PHI_Z_MON (D554) board.

Replacing Converter (C) Box Components

The converter box (C-Box) is located in the rotating part of the Gantry (see).

This section describes the replacement procedures for the following C-Box components (see):

- Back plane of the C-Box (E510)
- Dpu_1 board (E540)
- Dpu_2 board (E541)
- DELPHI board (D515)
- Z_CON board (D514)
- ACU board (D513)
- Optional DOM board (D516)

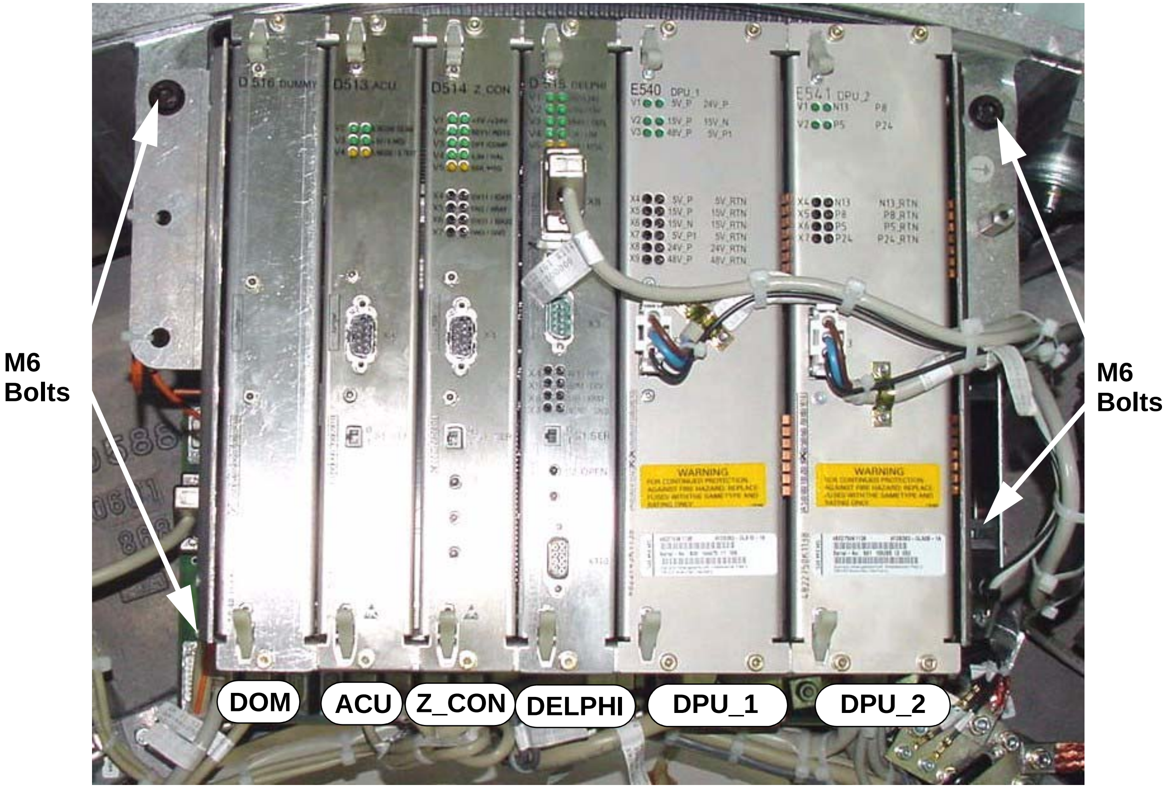

M6
Bolts
M6
Bolts
D516 DUMMY
D513 ACU
D514 Z_CON
D515 DELPHI
E540 DPU_1
E541 DPU_2
WARNING
WARNING
DOM
ACU
Z_CON
DELPHI
DPU_1
DPU_2

Figure 3-94: The Boards in the C-Box

Replacing the Back Plane of the C-Box (E510)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration to connect or install replacement parts correctly.

Tools and Auxiliary Materials Required

- The following tools and auxiliary materials are required to replace the back plane of the C-Box:
- A standard service tool kit
- 3 Nm - 20 Nm torque wrench with 7 mm (1/4") and 5 mm (1/5") Allen attachments
- 7 mm (1/4") extension, at least 300 mm (12") long
- Self-locking M4 nuts and M6 safety bolts, as required

Preparations

Prepare to replace the back plane of the C-Box as follows:

1. Move the couch to its outer and lowest position.
2. Loosen the two screws on the gantry front cover, remove the Plexiglas ring, and open the front cover.

⚠ **WARNING** ⚠

TURN THE SWITCH ‘S301’ TO THE OFF POSITION.

⚠ **WARNING** ⚠

BEFORE PERFORMING THE WORK, TURN THE GANTRY OFF FROM THE CT-BOX.

WARNING

TURN OFF THE F9 SWITCH IN THE PDC TO DISCHARGE THE VOLTAGE TO THE DPU_2 BOARD.
CHECK THAT THE DPU_2 LEDS ARE OFF, THEREBY ENSURING THAT THERE IS NO LONGER ANY VOLTAGE ON THE DPU_2 BOARD.

3. Rotate the Gantry by hand until the tube C-Box is in the 1 o’clock position.
4. Secure the rotating part of the Gantry with the safety bolt.

WARNING

DO NOT BEGIN WORKING ON THE ROTATING PART OF THE GANTRY UNTIL THE PROTECTIVE CONDUCTOR BETWEEN THE STATIONARY AND ROTATING PARTS OF THE GANTRY IS CONNECTED. THE PROTECTIVE CONDUCTOR IS INCLUDED IN THE SERVICE TOOL KIT.

Removing the Old C-Box Back Plane

Remove the old C-Box back plane as follows:

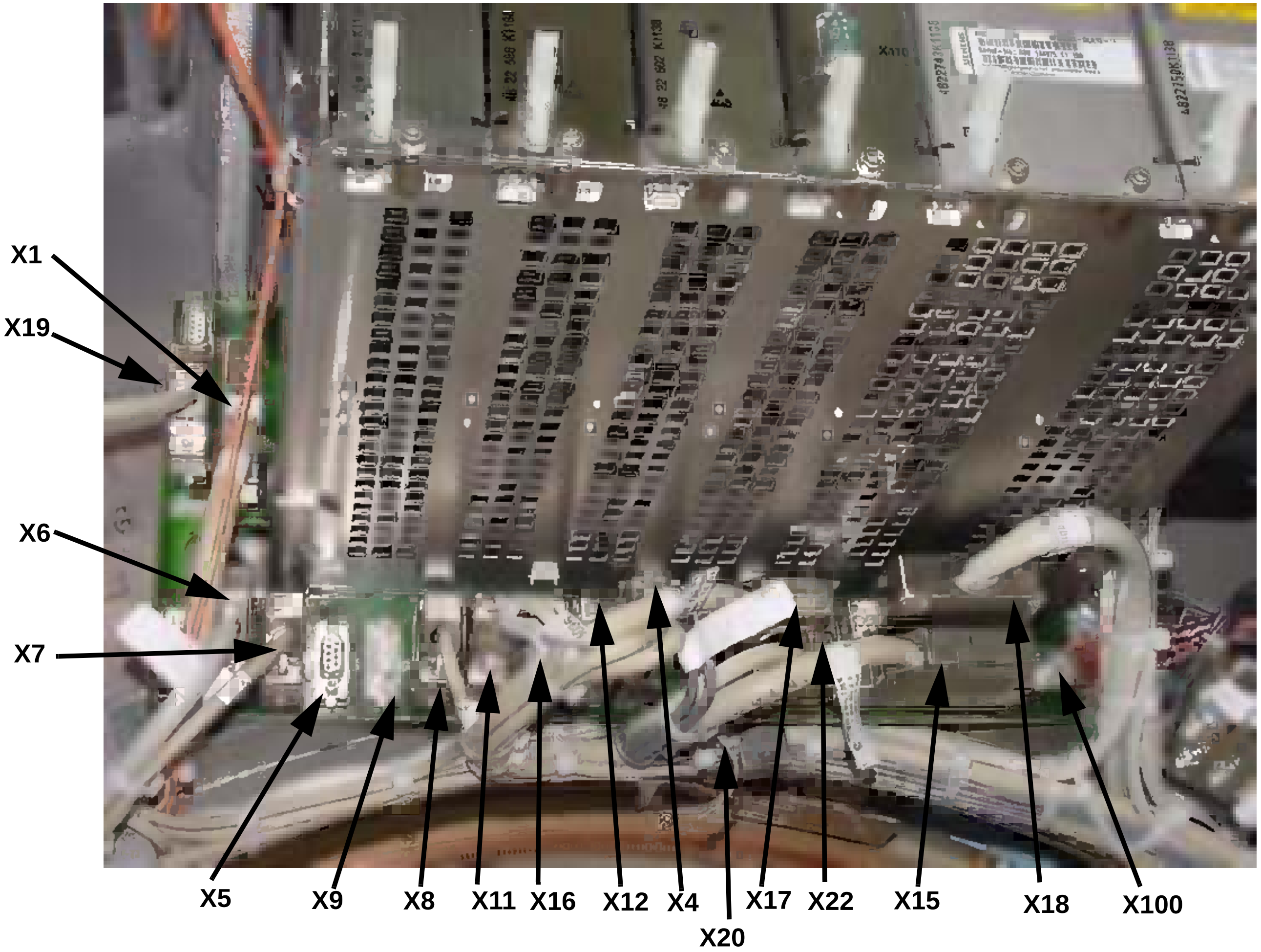

X1
X19
X6
X7
X5
X9
X8
X11
X16
X12
X4
X20
X17
X22
X15
X18
X100

Figure 3-95: The C-Box and its Connections

1. Disconnect the following cables and connectors on the front of the C-Box (see *Figure 3-95*):
    - X15
    - X17
    - X18
    - X20
    - X22
    - X3
    - X100 (ground strap)
    - X4
    - X12
    - X16
    - X11
    - X19
    - X8
    - X5
    - X9
    - X7
    - X6
    - X1
2. Remove the fibre optic cable that is attached either to the frame of the C-Box or to the optional DOM board, if there is one.
3. Disconnect X8 from the DELPHI board (D515).
4. Disconnect X3 from the DPU_1 and DPU_2 boards.
5. Remove all cable ties and clamps that interfere with removal of the C-Box.
6. Remove the four M6 mounting bolts shown in *Figure 3-94*.
7. Remove the C-Box.

Installing the New C-Box Back Plane

Install the new C-Box back plane as follows:

1. Insert the new back plane and tighten the four M6 mounting bolts shown in *Figure 3-95* with a torque of 24 Nm.

⚠ **CAUTION**

REPLACE ALL SELF-LOCKING NUTS AND SAFETY BOLTS THAT HAVE BEEN USED THREE TIMES WITH NEW ONES.

2. Reconnect cables, connectors and brackets to restore the original configuration.
3. Transfer all components (e.g., boards, fans, brackets) to be retained from the back plane of the old C-Box to the new one.
4. Secure all cables and connectors with cable ties and clamps.
5. Check that all connections of boards transferred from the old C-Box back plane comply with CMOS guidelines.

Final Steps

Complete replacement of the C-Box back plane as follows:

1. Release the Rotor locking pin.
2. Rotate the Gantry by hand and check for parts that are loose or touch other parts.
3. Switch the F9 switch in the PDC to the On position
4. Turn the Gantry ON from the CT-Box.
5. Turn the switch ‘S301’ to the ON position.
6. Perform some scans in various modes to ensure the proper functioning of the newly installed C-Box back plane, and of the entire system.
7. Close the Gantry front cover, install the Plexiglas ring and tighten the two screws in the lower part of the front cover.

Replacing the DPU_1 Board (E540)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you can connect or install replacement parts correctly.

You only need a standard service kit to replace the DPU_1 board.

Preparations

Prepare to replace the DPU_1 board as follows:

1. Position the X-ray tube in the 12 o'clock position, so that the C-Box is in the 9 o'clock position.

WARNING

SWITCH OFF THE GANTRY WITH THE COMP ON SWITCH.

WARNING

BEFORE PERFORMING THE WORK, TURN THE GANTRY OFF FROM THE CT-BOX.

2. Rotate the Gantry by hand until the tube collimator assembly is in the 12 o'clock position.
3. Secure the rotating part of the Gantry with the safety bolt.

WARNING

DO NOT BEGIN WORKING ON THE ROTATING PART OF THE GANTRY UNTIL THE PROTECTIVE CONDUCTOR BETWEEN THE STATIONARY AND ROTATING PARTS OF THE GANTRY IS CONNECTED. (THE PROTECTIVE CONDUCTOR IS INCLUDED IN THE SERVICE TOOLS KIT.)

Removing the Old DPU_1 Board

Remove the old DPU_1 board as follows:

1. Disconnect connector X3 from the old board.
2. Remove all cable ties and clamps that interfere with removal of the board.
3. Remove the board.

Installing the New DPU_1 Board

After removing the old board, install the new one as follows:

1. Insert the new board and tight all screws.
2. Connect connector X3.
3. Reconnect cables, connectors and brackets to restore the original configuration.

Final Steps

Complete replacement of the DPU_1 board as follows:

1. Release the rotor safety bolt.
2. Turn the Gantry ON from the CT-Box.
3. Ensure, that, all DPU_1 LEDs are lit.
4. Turn switch ‘S301’ to the ON position.
5. Perform some scans in different modes to ensure proper functioning of the newly installed DPU_1 Board and entire system.
6. Close the Gantry front cover, install Plexiglas ring and tighten the two screws in the lower part of the front cover.

No adjustment is required.

Replacing the DPU_2 Board (E541)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You only need a standard service kit to replace the DPU_2 board.

Preparations

Prepare to replace the DPU_2 board as follows:

1. Position the X-ray tube in the 12 o’clock position, so that the C-Box is in the 9 o’clock position.
2. Switch OFF the Gantry with the **COMP ON** switch.
3. Switch OFF the F9 fuse in the PDC to discharge the voltage in DPU_2.
4. Check the DPU_2 LEDs to make sure that there is no longer any voltage in DPU_2.
5. Open the front door of the Gantry and set service switch S203 to OFF (set it to 0).

NOTE:

Do not begin working on the rotating part of the Gantry until the protective conductor between the stationary and rotating parts of the Gantry is connected. (The protective conductor is included in the service tools kit.)

6. Secure the rotating part of the Gantry with the safety bolt.

Removing the Old DPU_2 Board

Remove the old DPU_2 board as follows:

1. Disconnect X3 from the old board.

2. Remove all cable ties and clamps that interfere with removal of the board.
3. Remove the board.

Installing the New DPU_2 Board

After removing the old board, install the new one as follows:

1. Insert the new board.
2. Reconnect cables, connectors and brackets to restore the original configuration.

Final Steps

Complete replacement of the DPU_1 board as follows:

1. Secure all cables and connectors with cable ties and clamps.
2. Switch ON the system.
3. Switch on fuse F9 in the PDC.
4. When the system is in **Standby** mode, check that all four DPU_2 LEDs are flashing.
5. Perform scans with and without radiation.
6. Attach all covers and the Plexiglas ring.

Replacing the DELPHI Board (D515)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You only need a standard service kit to replace the DELPHI board.

Preparations

Prepare to replace the DELPHI board as follows:

1. Position the X-ray tube in the 12 o'clock position, so that the C-Box is in the 9 o'clock position.
2. Switch OFF the Gantry with the **COMP ON** switch.
3. Open the front door of the Gantry and set service switch S203 to OFF (set it to 0).

> **NOTE:**
>
> Do not begin working on the rotating part of the Gantry until the protective conductor between the stationary and rotating parts of the Gantry is connected. (The protective conductor is included in the service tools kit.)

4. Secure the rotating part of the Gantry with the safety bolt.

Removing the Old DELPHI Board

Remove the old DELPHI board as follows:

1. Disconnect X8 from the old board.
2. Remove all cable ties and clamps that interfere with removal of the board.
3. Remove the board.

Installing the New DELPHI Board

After removing the old board, install the new one as follows:

1. Insert the new board.
2. Reconnect cables, connectors and brackets to restore the original configuration.

Final Steps

Complete replacement of the DELPHI board as follows:

1. Secure all cables and connectors with cable ties and clamps.
2. Switch ON the system.
3. When the system is in **Standby** mode, perform scans with and without radiation.
4. Attach all covers and the Plexiglas ring.

Replacing the Z_CON Board (D514)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You only need a standard service kit to replace the Z_CON board.

Preparations

Prepare to replace the Z_CON board as follows:

1. Position the X-ray tube in the 12 o’clock position, so that the C-Box is in the 9 o’clock position.
2. Switch OFF the Gantry with the **COMP ON** switch.
3. Open the front door of the Gantry and set service switch S203 to OFF (set it to 0).

NOTE:

Do not begin working on the rotating part of the Gantry until the protective conductor between the stationary and rotating parts of the Gantry is connected. (The protective conductor is included in the service tools kit.)

4. Secure the rotating part of the Gantry with the safety bolt.

Removing the Old Z_CON Board

Remove the old Z_CON board as follows:

1. Remove all cable ties and clamps that interfere with removal of the board.
2. Remove the board.
3. Remove the MCB (D2) board from the Z_CON board.

Installing the New Z_CON Board

After removing the old board, install the new one as follows:

1. Install the old MCB (D2) board (that you took off the old Z_CON board) on the new Z_CON board.
2. Insert the new Z_CON board.
3. Reconnect cables, connectors and brackets to restore the original configuration.

Final Steps

Complete replacement of the Z_CON board as follows:

1. Secure all cables and connectors with cable ties and clamps.
2. Switch ON the system.
3. When the system is in **Standby** mode, perform scans with and without radiation.
4. Attach all covers and the Plexiglas ring.

Replacing the ACU Board (D513)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You only need a standard service kit to replace the ACU board.

Preparations

Prepare to replace the ACU board as follows:

1. Position the X-ray tube in the 12 o’clock position, so that the C-Box is in the 9 o’clock position.
2. Switch OFF the Gantry with the **COMP ON** switch.
3. Open the front door of the Gantry and set service switch S203 to OFF (set it to 0).

> **NOTE:**
>
> Do not begin working on the rotating part of the Gantry until the protective conductor between the stationary and rotating parts of the Gantry is connected. (The protective conductor is included in the service tools kit.)

4. Secure the rotating part of the Gantry with the safety bolt.

Removing the Old ACU Board

Remove the old ACU board as follows:

1. Remove all cable ties and clamps that interfere with removal of the board.
2. Remove the board.
3. Remove the MCB (D2) board from the ACU board.

Installing the New ACU Board

After removing the old board, install the new one as follows:

1. Install the old MCB (D2) board (that you took off the old ACU board) on the new ACU board.
2. Insert the new ACU board.
3. Reconnect cables, connectors and brackets to restore the original configuration.

Final Steps

Complete replacement of the ACU board as follows:

1. Secure all cables and connectors with cable ties and clamps.
2. Switch ON the system.
3. When the system is in **Standby** mode, perform scans with and without radiation.
4. Attach all covers and the Plexiglas ring.

Replacing the Rotating Light Markers (E581-4)

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

You only need a standard service kit to replace the light markers.

Table 3-29 shows the locations and connections of the light markers. It also indicates the Gantry position for replacing each one.

Table 3-29: Locations and Connections of Rotating Light Markers

LIGHT MARKER	LOCATION	CONNECTIONS	X-RAY TUBE POSITION
D2 E581	Left of tube diaphragm.	X2	12 o’clock
D2 E582	Right of tube diaphragm.	X3, X4	12 o’clock
D2 E583	Left of detector.	X4	9 o’clock
D2 E584	Right of detector.	X2, X3, X4	3 o’clock

Preparations

Prepare to replace rotating light markers as follows:

1. Rotate the Gantry until the X-ray tube is in the desired position. *Table 3-29* shows the correct position for each of the light markers.
2. For example, to replace light marker E584, position the X-ray tube in the 3 o’clock position.
3. Switch OFF the Gantry with the **COMP ON** switch.
4. Open the front door of the Gantry and set service switch S203 to OFF (set it to 0).

> **NOTE:**
>
> Do not begin working on the rotating part of the Gantry until the protective conductor between the stationary and rotating parts of the Gantry is connected. (The protective conductor is included in the service tools kit.)

5. Secure the rotating part of the Gantry with the safety bolt.

Removing the Old Light Marker

Remove the old light markers as follows:

1. Disconnect the connectors attached to the light marker (see *Table 3-29*).
2. Remove the two M6 bolts that hold the light marker in place. (For light marker E584, see *Figure 3-96*.)

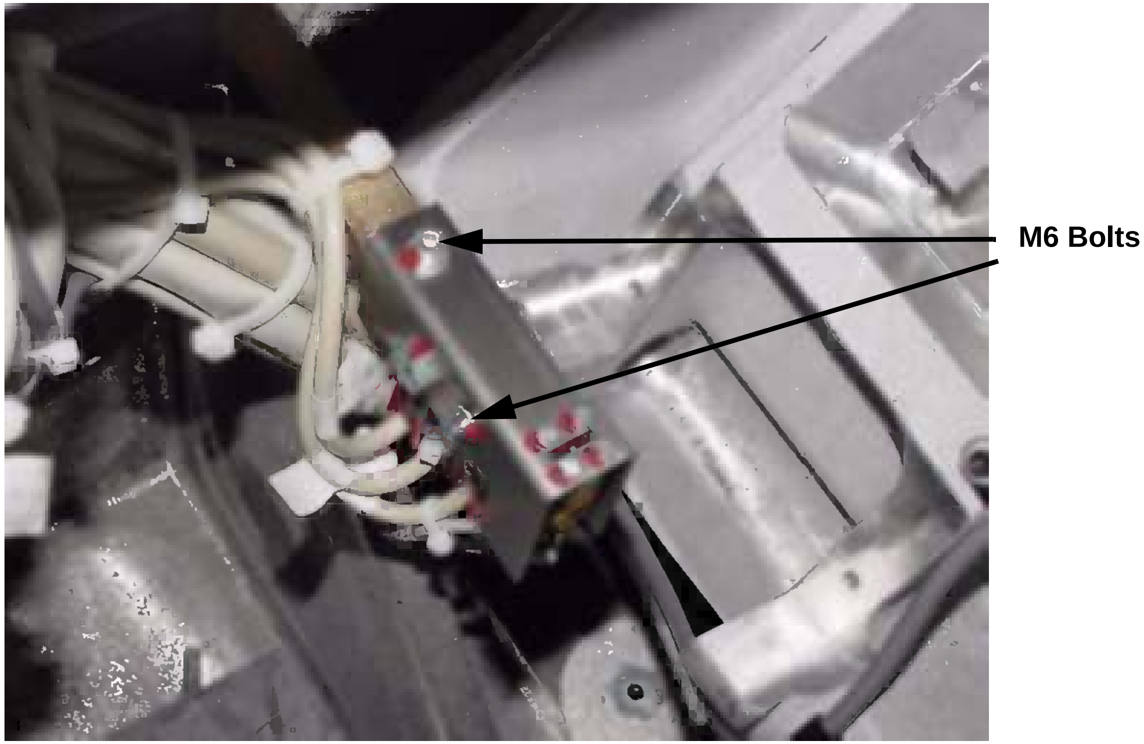


Figure 3-96: M6 Bolts for Light Marker E584

3. Remove the light marker, together with the mounting bracket.

NOTE:

Do not adjust the position of the light marker brackets at this time.

Installing the New Light Marker

After removing the old light marker, install the new one as follows:

1. Insert the new light marker, together with the mounting bracket.
2. Insert the two M6 bolts that hold the light marker in place.
3. Attach the appropriate connectors to the light marker.

Final Steps

Complete replacement of the light marker as follows:

1. Close the door of the Gantry and insert the Plexiglas ring carefully.
2. Use the Gantry panels to check that the light markers are working correctly.
3. Adjust the light markers, as necessary.

DMS (Data Measurement System)

DMS Overview

The DMS (Data Measurement System) is located in the Gantry Rotating unit. It receives X radiation from the XRS which is attenuated by the patient, converts it to electrical current by the detectors, integrates the current, digitizes the data, and transfers it to the ACQ card for processing.

Detector data is transferred through capacitance slip-ring media from the rotor to the stator at a transfer rate of 200 Mbit/sec.

Figure 3-97 shows the general block diagram of the Mx8000 system.

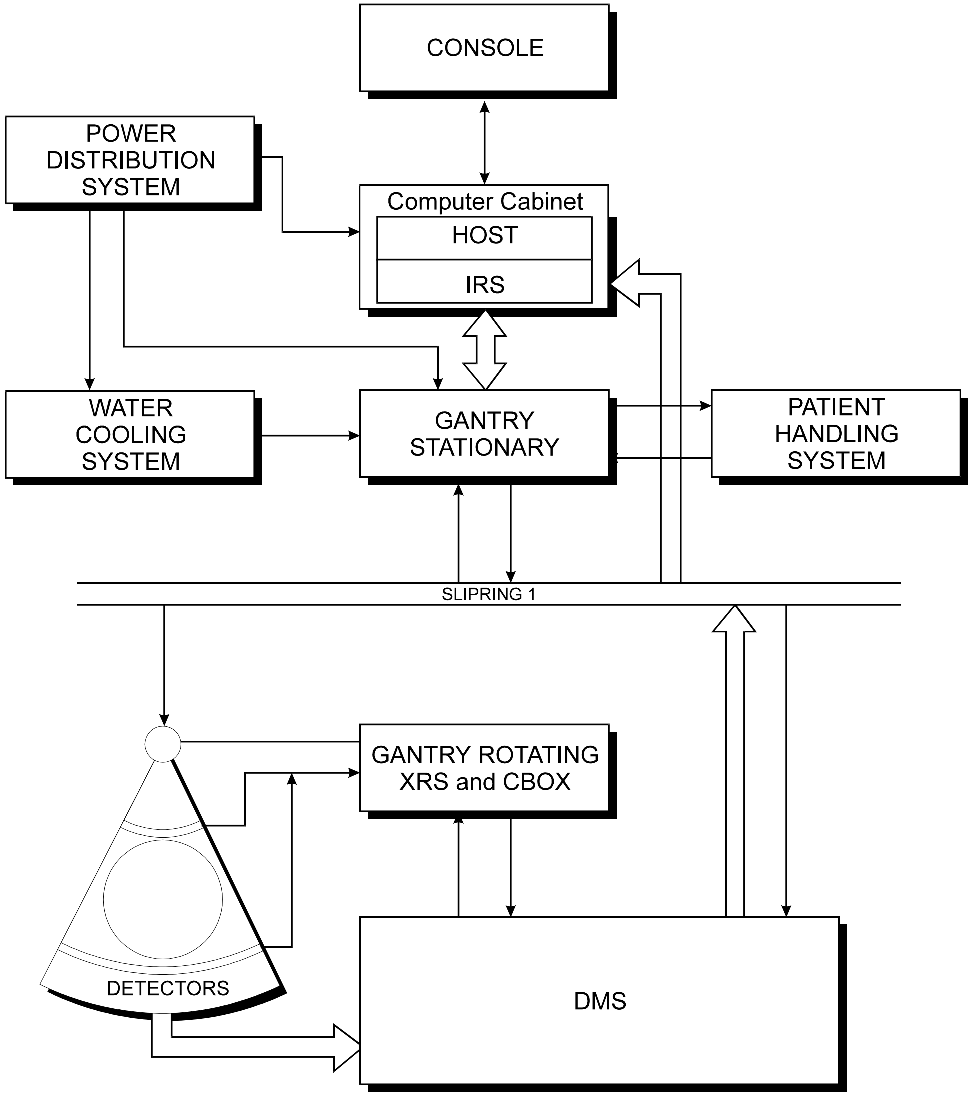

CONSOLE
POWER DISTRIBUTION SYSTEM
Computer Cabinet
HOST
IRS
WATER COOLING SYSTEM
GANTRY STATIONARY
PATIENT HANDLING SYSTEM
SLIPRING 1
GANTRY ROTATING XRS and CBOX
DETECTORS
DMS

Figure 3-97: System Block Diagram

The DMS includes the following units as shown in *Figure 3-98*:

- Detectors
- GI
- RCOM
- Lower Beam (Collimators)

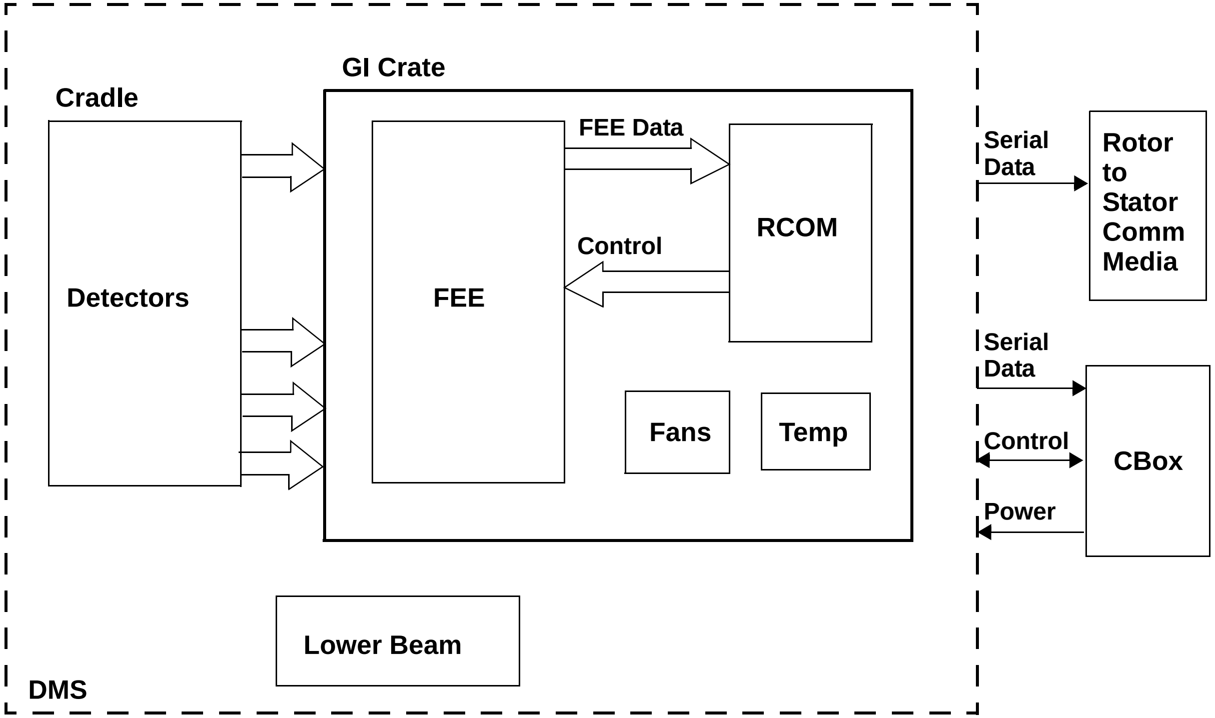

GI Crate
Cradle
Detectors
FEE Data
FEE
Control
RCOM
Fans
Temp
Lower Beam
DMS
Serial Data
Rotor to Stator Comm Media
Serial Data
Control
Power
CBox

Figure 3-98: DMS Block Diagram

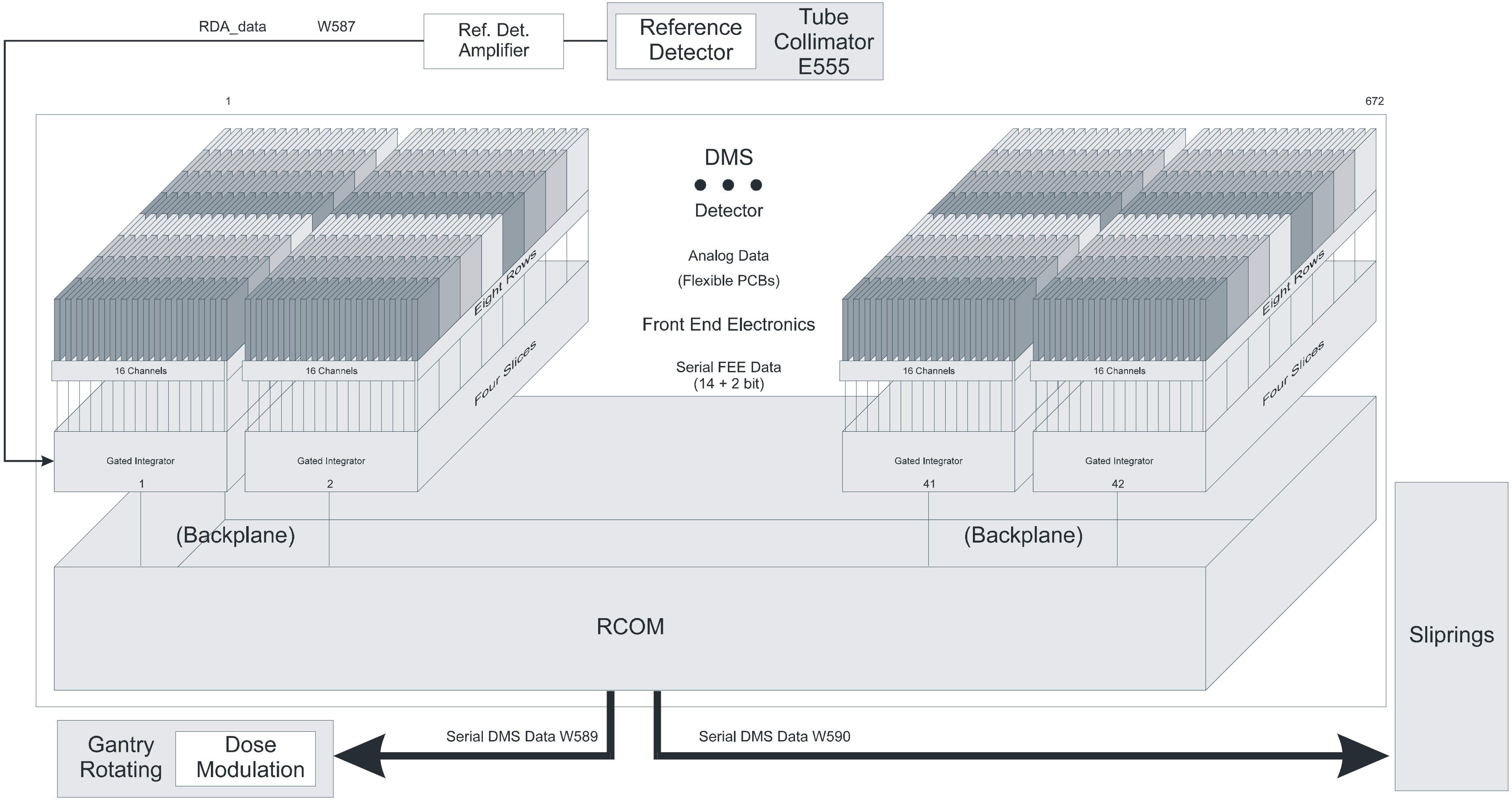

RDA_data
W587
Ref. Det. Amplifier
Reference Detector
Tube Collimator E555
1
672
DMS
Detector
Analog Data
(Flexible PCBs)
Front End Electronics
Serial FEE Data
(14 + 2 bit)
Eight Rows
Four Slices
16 Channels
16 Channels
16 Channels
16 Channels
Gated Integrator
1
Gated Integrator
2
Gated Integrator
41
Gated Integrator
42
(Backplane)
(Backplane)
RCOM
Sliprings
Gantry Rotating
Dose Modulation
Serial DMS Data W589
Serial DMS Data W590

Figure 3-99: DMS Data Flow

The DMS includes the following components:

- **Cradle** - A massive and very accurate mechanical plate that carries the detector array. The lower beam assembly is also mounted on the cradle.

  The lower beam includes the mechanics of the p-plane collimator and the Ultra-High Resolution (UHR) collimator: motors, encoders and limit switches.

  The p-plane collimator (detector collimator) is a varying slit collimator that adjusts beam thickness to the detection array.

  The UHR collimator includes slit holes in the Z direction, which mask part of the detector area. The collimator has two positions: in and out.

- **GI Crate** - An assembly which includes the backplane, FEE, RCOM, fans and temperature monitoring.

The GI crate includes the following:

- FEE - The detector modules are connected to the GI cards. The GI cards multiplex the detector output to generate up to four slices of 672 detectors each. The detector current is integrated during **subfan** time, digitized and transferred to the RCOM.

  The GI cards and RCOM are connected by the DMS backplane. The DMS backplane is made of three backplanes connected by flat cables.

- RCOM - This card interfaces to the CBOX, controls the FEE and transfers data collected by the FEE to the ACQ card and DOM card.
- FANS - Two internal fans dissipate the heat from the DMS. The fans are mounted on the GI crate cover and receive power from the power distribution card.
- The following temperature measurements devices:
  - A temperature switch that switches OFF the power to the FEE when the FEE temperature exceeds 35^{0}C, and switches the power ON again when the FEE temperature drops below 25^{0}C.
  - Two temperature sensors, one on either side of the GI Crate cover, transfer the information to the ACU.
  - A third temperature sensor, on the cradle, transfers temperature data with the detector data to the IRS.

The C-BOX assembly contains the cards which control the DMS and supply power from DPU_2, as follows:

- 5.5 ± 2% VDC - 8 Amp
- 8 ± 2% VDC - 15 Amp
- -13 ± 2% VDC - 14 Amp
- 24 ± 8% VDC - 2 Amp

Detectors

The detection array measures the intensity of X-Ray radiation transmitted through the patient. The Mx8000 detection array is based on Philips' common scintillator-photo diode technology. Each detector has four segments of scintillator crystals separated by light-reflecting material mounted on a linear array photodiode with an appropriate output connection.

The detectors are mounted in modules.

The 32 detectors are arranged in 16 columns per module, 42 modules per detection array. Each functional column contains two adjacent detectors.

The anti-scatter cassette is a grid of metal foil with plastic spacers inserted between the detectors and aligned radially relative to the XRT focal spot. Its function is to reduce scatter radiation at the detectors.

Flexible rigid PCBs connect the outputs to the GI input. The cable is part of the module and connects to the GI card with a 160 pin connector.

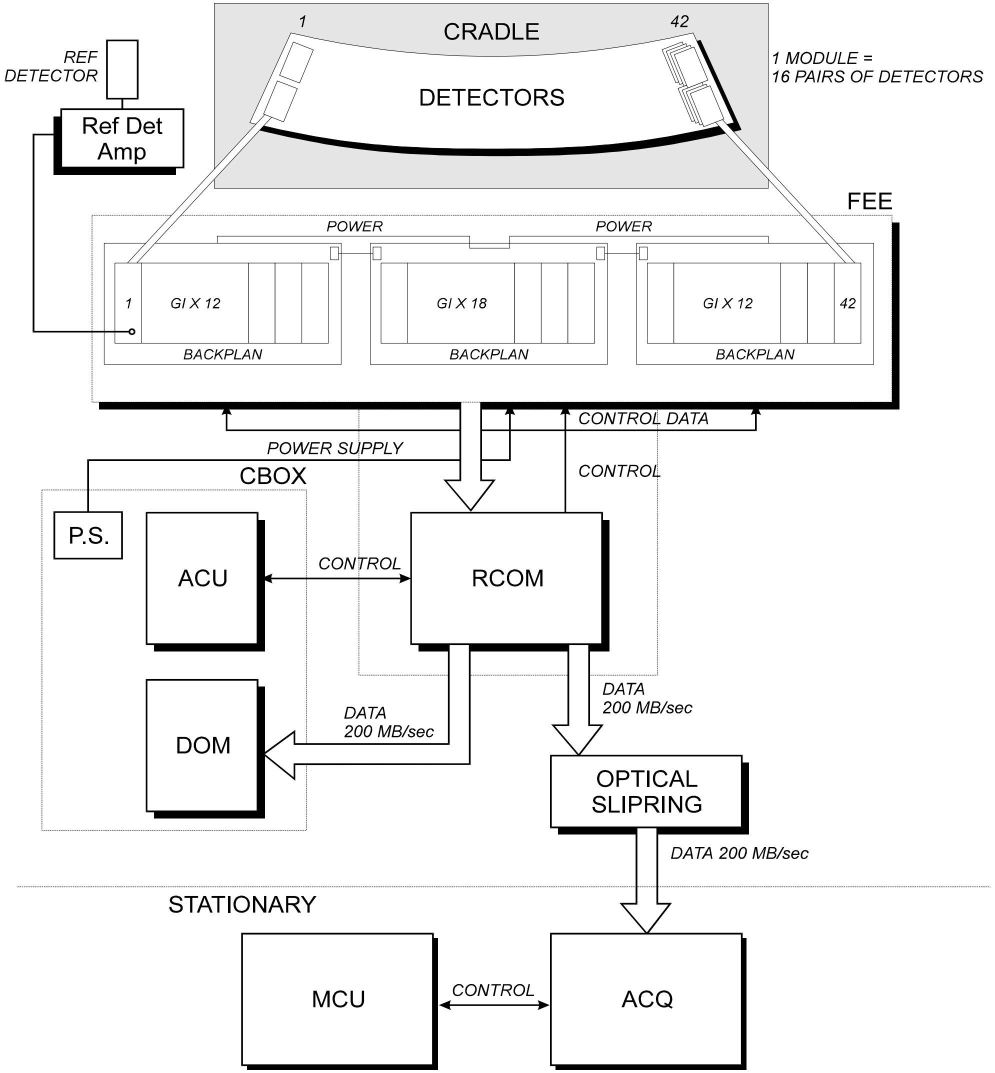

CRADLE
1
42
DETECTORS
1 MODULE =
16 PAIRS OF DETECTORS
REF
DETECTOR
Ref Det
Amp
FEE
POWER
POWER
1
GI X 12
GI X 18
GI X 12
42
BACKPLAN
BACKPLAN
BACKPLAN
CONTROL DATA
POWER SUPPLY
CBOX
CONTROL
P.S.
ACU
CONTROL
RCOM
DOM
DATA
200 MB/sec
DATA
200 MB/sec
OPTICAL
SLIPRING
DATA 200 MB/sec
STATIONARY
MCU
CONTROL
ACQ

Figure 3-100: Data Flow Diagram

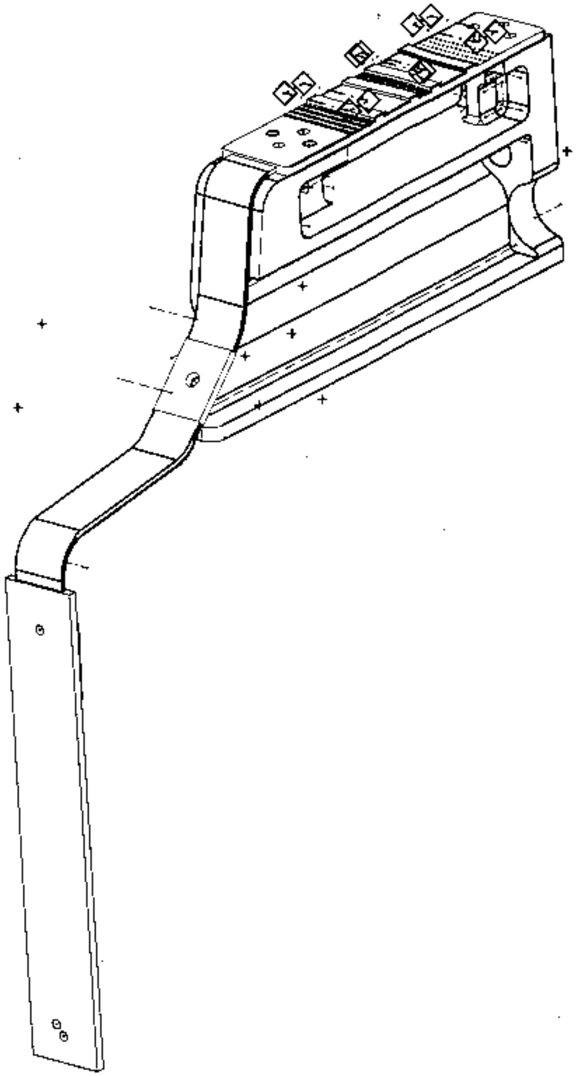


Figure 3-101: Detector Module

Gated Integrator (GI) Cards

GI Cards Overview

There are 42 Gated Integrator (GI) cards in the GI crate. The GI card processes the input current of 32 detectors (128 segments). After multiplexing integration and sampling, detector segment output signals are converted into 16 x 4 channels (four slices). All channels are converted to digital format data.

42 lines (one from each GI card) carry the serial digital data from each GI card to the RCOM. All lines are differential.

The GI card receives the following signals from which it generates its own timing signals.

- 5 MHz clock
- **Subfan** signal
- Convert signal (**strconv**)
- Serial FEE mode data
- GI reset (reload)

All are differential.

Each GI card receives the following power supplies:

- 5VDC ±0.25V 100 mA
- -12 VDC ±0.5V 280 mA
- 7 VDC ±0.5V 280 mA

Every GI card receives a special code of six bits, which is hard-wired on the backplane. This code denotes GI locations and identification.

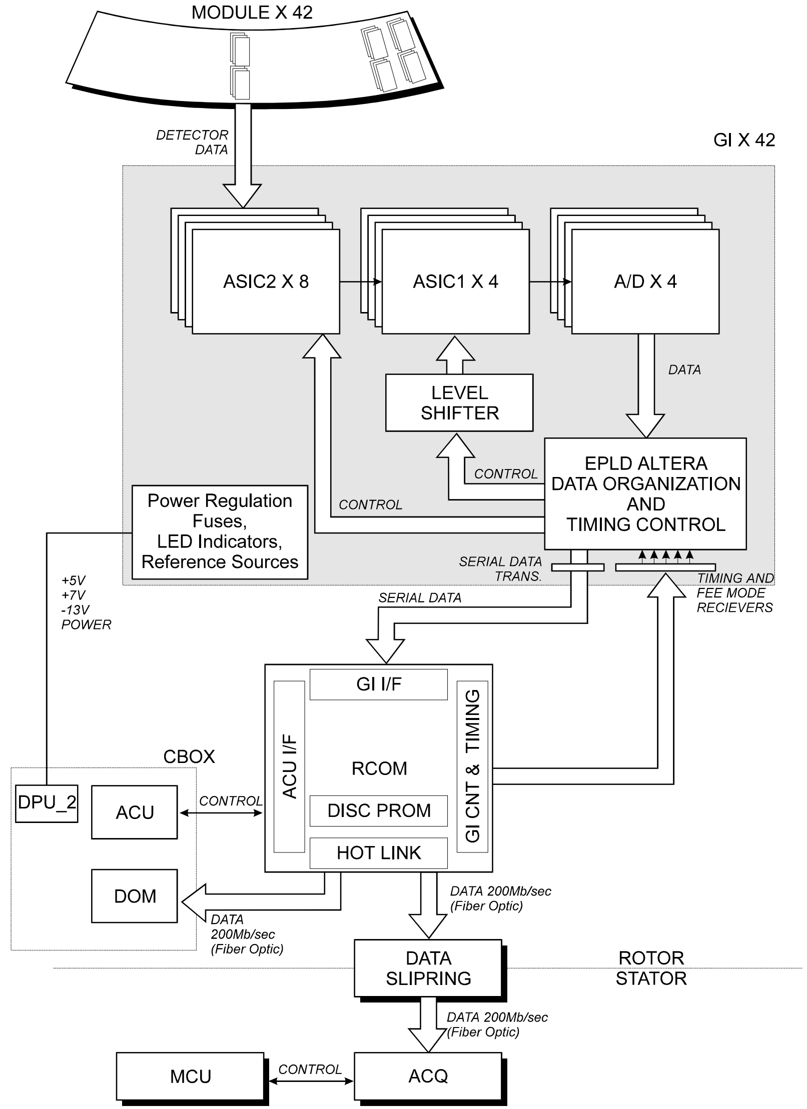

MODULE X 42
DETECTOR DATA
GI X 42
ASIC2 X 8
ASIC1 X 4
A/D X 4
LEVEL SHIFTER
DATA
CONTROL
CONTROL
EPLD ALTERA DATA ORGANIZATION AND TIMING CONTROL
Power Regulation Fuses, LED Indicators, Reference Sources
SERIAL DATA TRANS.
TIMING AND FEE MODE RECIEVERS
+5V
+7V
-13V
POWER
SERIAL DATA
GI I/F
ACU I/F
RCOM
GI CNT & TIMING
DISC PROM
HOT LINK
CBOX
DPU_2
ACU
CONTROL
DOM
DATA 200Mb/sec (Fiber Optic)
DATA 200Mb/sec (Fiber Optic)
DATA SLIPRING
ROTOR
STATOR
DATA 200Mb/sec (Fiber Optic)
MCU
CONTROL
ACQ

Figure 3-102: GI Card Interconnection

GI Card Components

Every GI card has four identical blocks (see *Figure 3-103*). This section describes the components in each block.

Integrator

An integrator converts the 128 photo diode currents to voltage $v \alpha \frac{ixT}{c}$ where:

- i = input current
- T = integration time (indicated by the **subfan** signal)
- c = integration capacitance

The integration time and the integration capacitance are defined by the operation mode. The output data is 64 channels.

The Sample and Hold (S and H) Circuit and the Multiplexer

The output data of each channel is multiplied by a gain of 1, 2, 4, 8, controlled by the user selection of slice width. After MUX of 16:1, each channel is further multiplied by the range of 1, 4, 16 (marked as L, M. H) depending on the voltage range of the channel.

A/D Converter and EPLD

The analog channel is converted to 16 bit digital by the A/D used in the 14 MSb and 2 bit range. This data is sent serially to the RCOM from each GI.

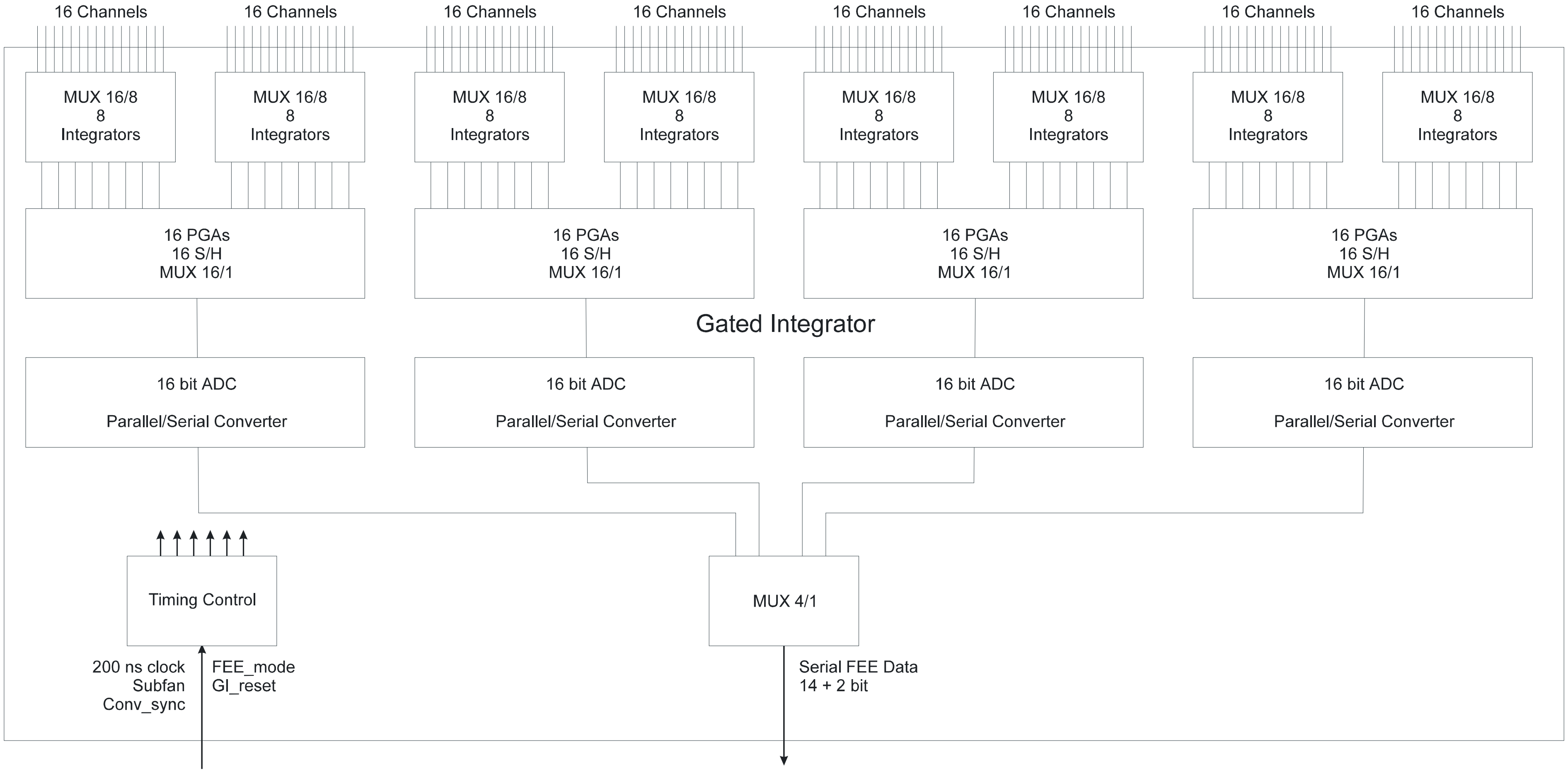

16 Channels
16 Channels
16 Channels
16 Channels
16 Channels
16 Channels
16 Channels
16 Channels
MUX 16/8 8 Integrators
MUX 16/8 8 Integrators
MUX 16/8 8 Integrators
MUX 16/8 8 Integrators
MUX 16/8 8 Integrators
MUX 16/8 8 Integrators
MUX 16/8 8 Integrators
MUX 16/8 8 Integrators
16 PGAs 16 S/H MUX 16/1
16 PGAs 16 S/H MUX 16/1
16 PGAs 16 S/H MUX 16/1
16 PGAs 16 S/H MUX 16/1
Gated Integrator
16 bit ADC Parallel/Serial Converter
16 bit ADC Parallel/Serial Converter
16 bit ADC Parallel/Serial Converter
16 bit ADC Parallel/Serial Converter
Timing Control
MUX 4/1
200 ns clock
Subfan
Conv_sync
FEE_mode
GI_reset
Serial FEE Data
14 + 2 bit

Figure 3-103: DMS Gated Integrator

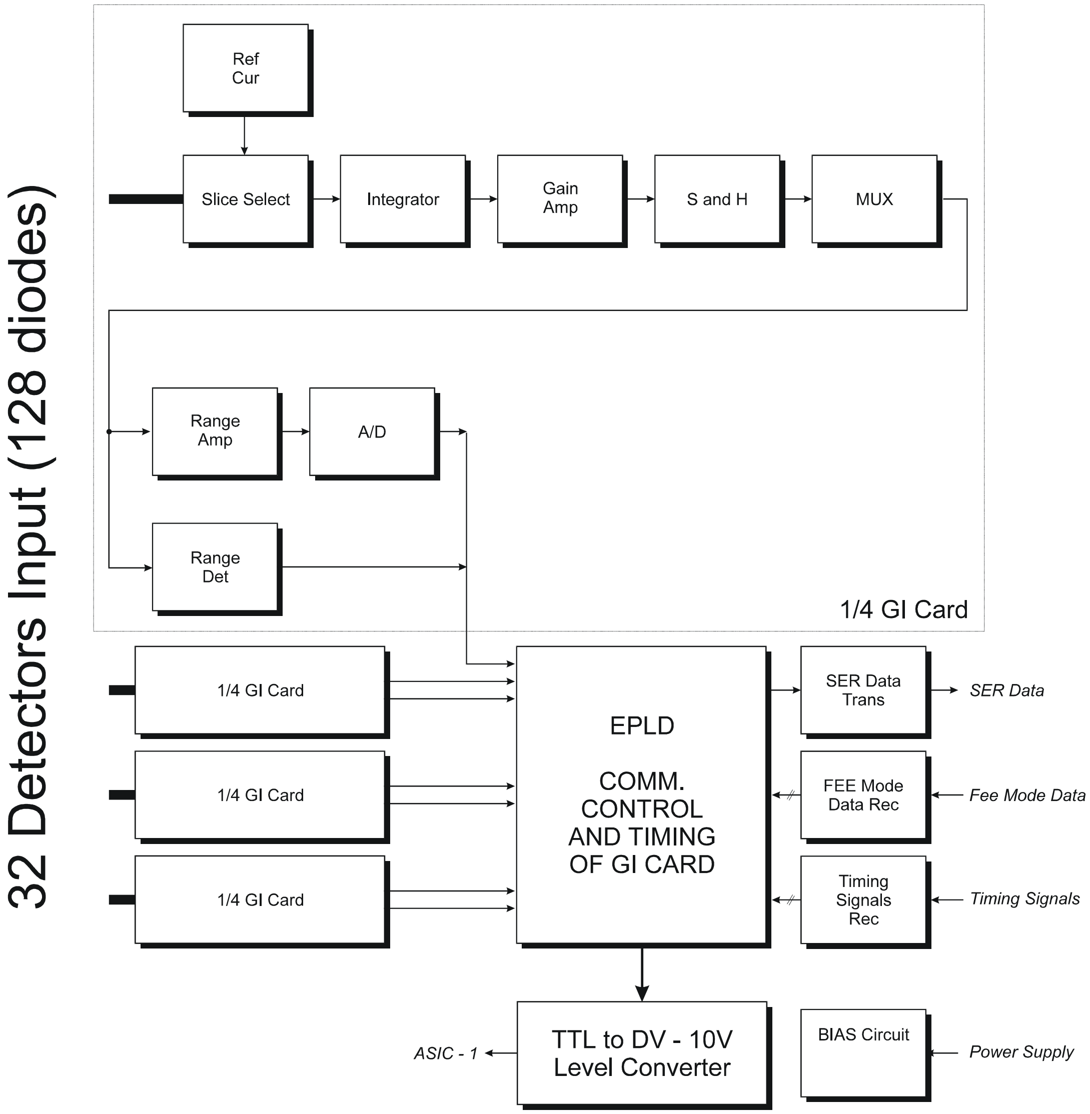

32 Detectors Input (128 diodes)
Ref Cur
Slice Select
Integrator
Gain Amp
S and H
MUX
Range Amp
A/D
Range Det
1/4 GI Card
1/4 GI Card
1/4 GI Card
1/4 GI Card
EPLD
COMM. CONTROL AND TIMING OF GI CARD
SER Data Trans
SER Data
FEE Mode Data Rec
Fee Mode Data
Timing Signals Rec
Timing Signals
TTL to DV - 10V Level Converter
ASIC - 1
BIAS Circuit
Power Supply

Figure 3-104: GI Block Diagram

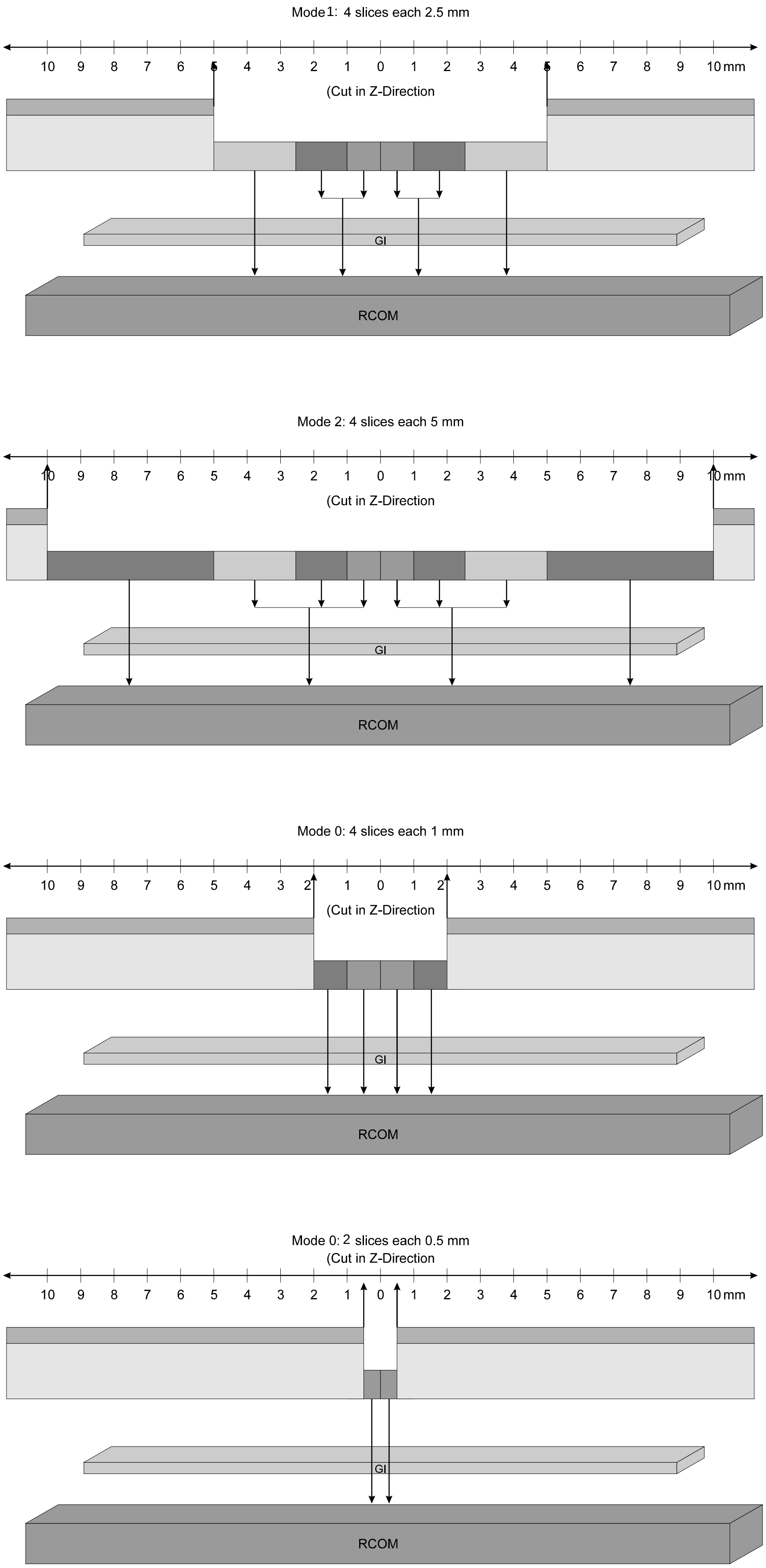

Mode 1: 4 slices each 2.5 mm
10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 mm
(Cut in Z-Direction
GI
RCOM
Mode 2: 4 slices each 5 mm
10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 mm
(Cut in Z-Direction
GI
RCOM
Mode 0: 4 slices each 1 mm
10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 mm
(Cut in Z-Direction
GI
RCOM
Mode 0: 2 slices each 0.5 mm
(Cut in Z-Direction
10 9 8 7 6 5 4 3 2 1 0 1 2 3 4 5 6 7 8 9 10 mm
GI
RCOM

Figure 3-105: Slice Modes

ASIC-2

There are eight ASIC-2s in the GI card. Each ASIC-2 handles four detectors (16 diode segments). The main blocks of the ASIC-2 are as follows:

- Slice select - Combination of three bits to select two groups of one, two, or three detector segments combined together to perform slice resolution. There are the following modes:
    - Mode 0 4 x 1 mm, 2 x 0.5
    - Mode 1 4 x 2.5 mm
    - Mode 2 4 x 5 mm
- Integrator - Selects the value of the integration capacitor inside the ASIC-2. Possible values are: 60 pF, 90 pF, or 150 pF.
- Input Select - Selects between real (detector) input or ASIC-2 internal current sources for the CDRH test and diagnostics.

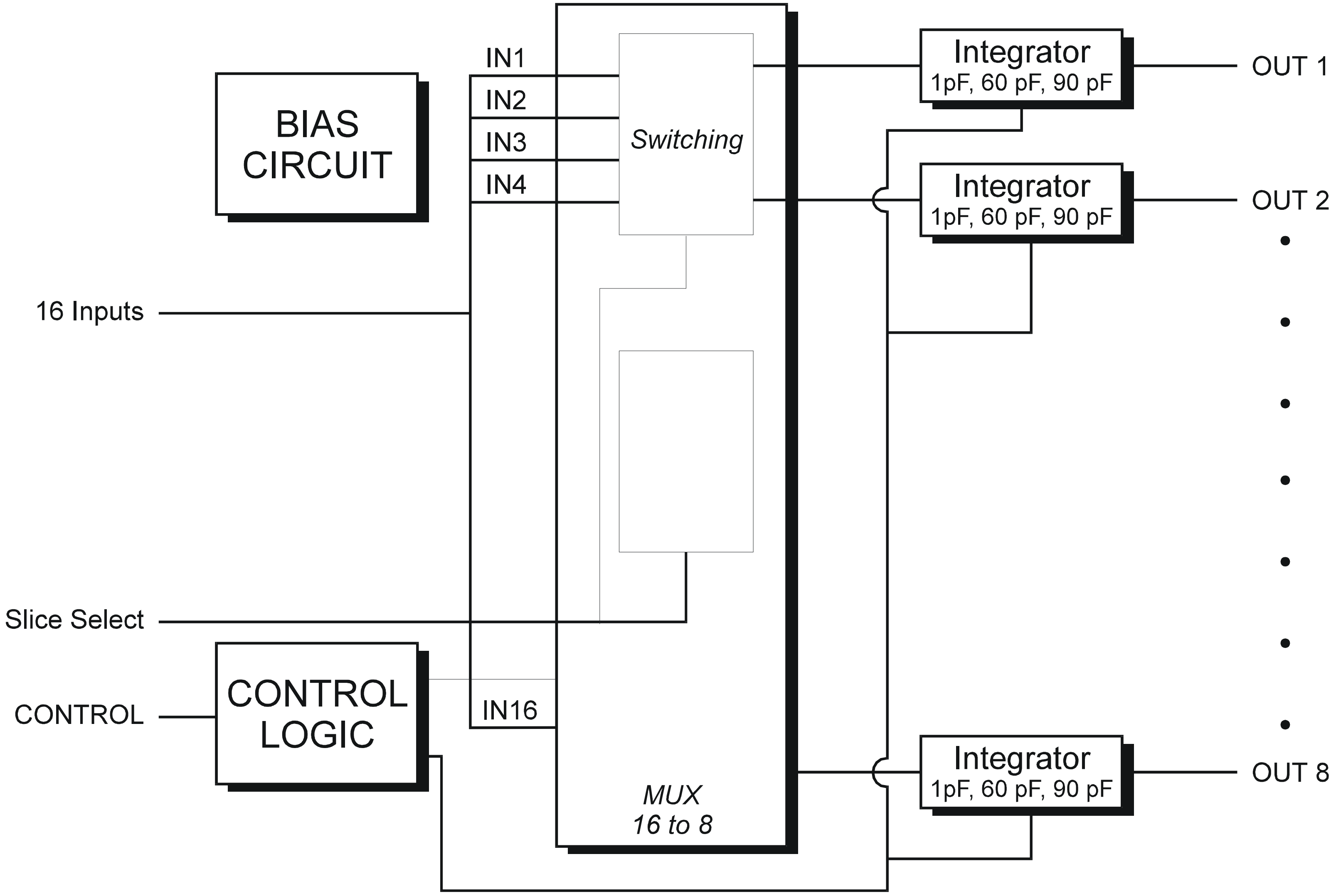

BIAS CIRCUIT
IN1
IN2
IN3
IN4
Switching
16 Inputs
Slice Select
CONTROL
CONTROL LOGIC
IN16
MUX
16 to 8
Integrator
1pF, 60 pF, 90 pF
OUT 1
Integrator
1pF, 60 pF, 90 pF
OUT 2
Integrator
1pF, 60 pF, 90 pF
OUT 8

Figure 3-106: ASIC-2 Wiring Diagram

ASIC-1

There are four ASIC-1s in the GI card. Each ASIC-1 handles two ASIC-2s (16 channels).

The main blocks in each ASIC-1 are as follows:

- Programmable Gain Amplifier (PGA): A value of 1, 4 or 8 multiplies the output of the ASIC-2. There are separated gains for A,B slices and C,D slices. The gain is selected according to the slice select.
- Sample and Hold (S and H in *Figure 3-107*) circuit holds the detector voltage. Duration depends on the time indicated by the **subfan** signal.
- Range (PGA)—Autorange or manual. The value of the range (1, 4 or 16) multiplies the analog output just before the A/D conversion, as follows:
  - — Low Range x 16
  - — Medium Range x 4
  - — High Range x 1

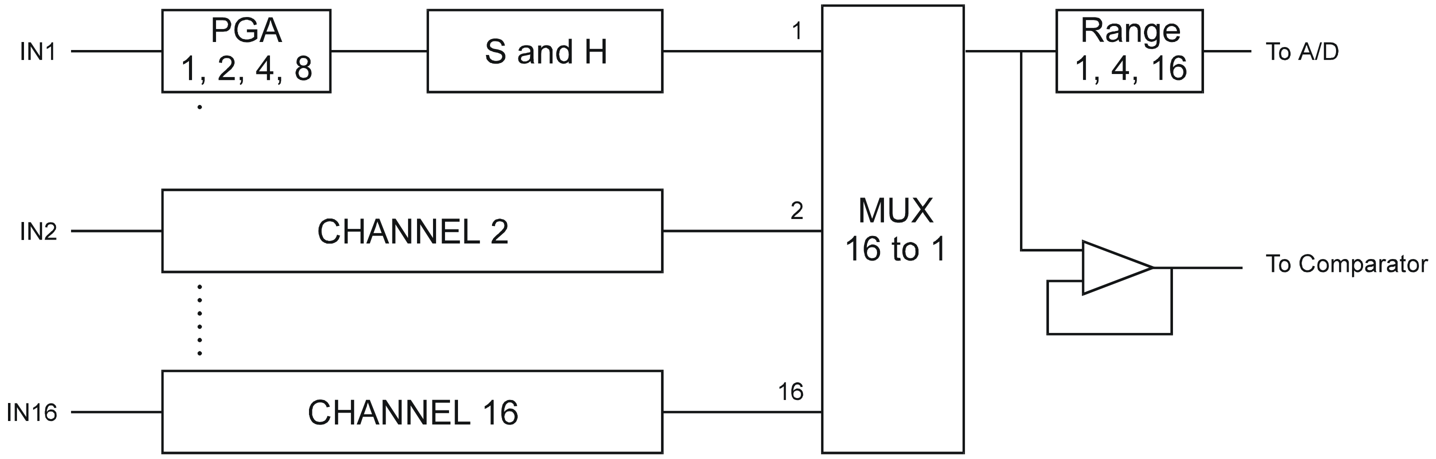

IN1
PGA
1, 2, 4, 8
S and H
1
IN2
CHANNEL 2
2
IN16
CHANNEL 16
16
MUX
16 to 1
Range
1, 4, 16
To A/D
To Comparator

Figure 3-107: ASIC-1 Wiring

A/D Converter

There are four A/D converters on each GI card. Each handles 16 channels, for a total of 16 x 4 channels of four slices each. Each A/D converter converts the analog voltage to 16 bit digital signals. Only 14 bits are used. Two more bits are used for range (L, M and H).

EPLD (ALTERA)

The EPLD component does the following:

- Generates timing for all of the internal signals for the GI card
- Receives serial line FEE mode data
- Sends one serial data output signal of 64 channels to the RCOM card. Each channel has 16 bits, where 14 bits are data and two bits specify range.
- Contains the assignment and constant data for diagnostics purposes.

BIAS Circuit

Produces DC voltages for the different components in the GI (ASIC-2, ASIC-1, A/D converter).

Level Shifter

Converts the TTL levels to ASIC-1 levels.

GI Interface

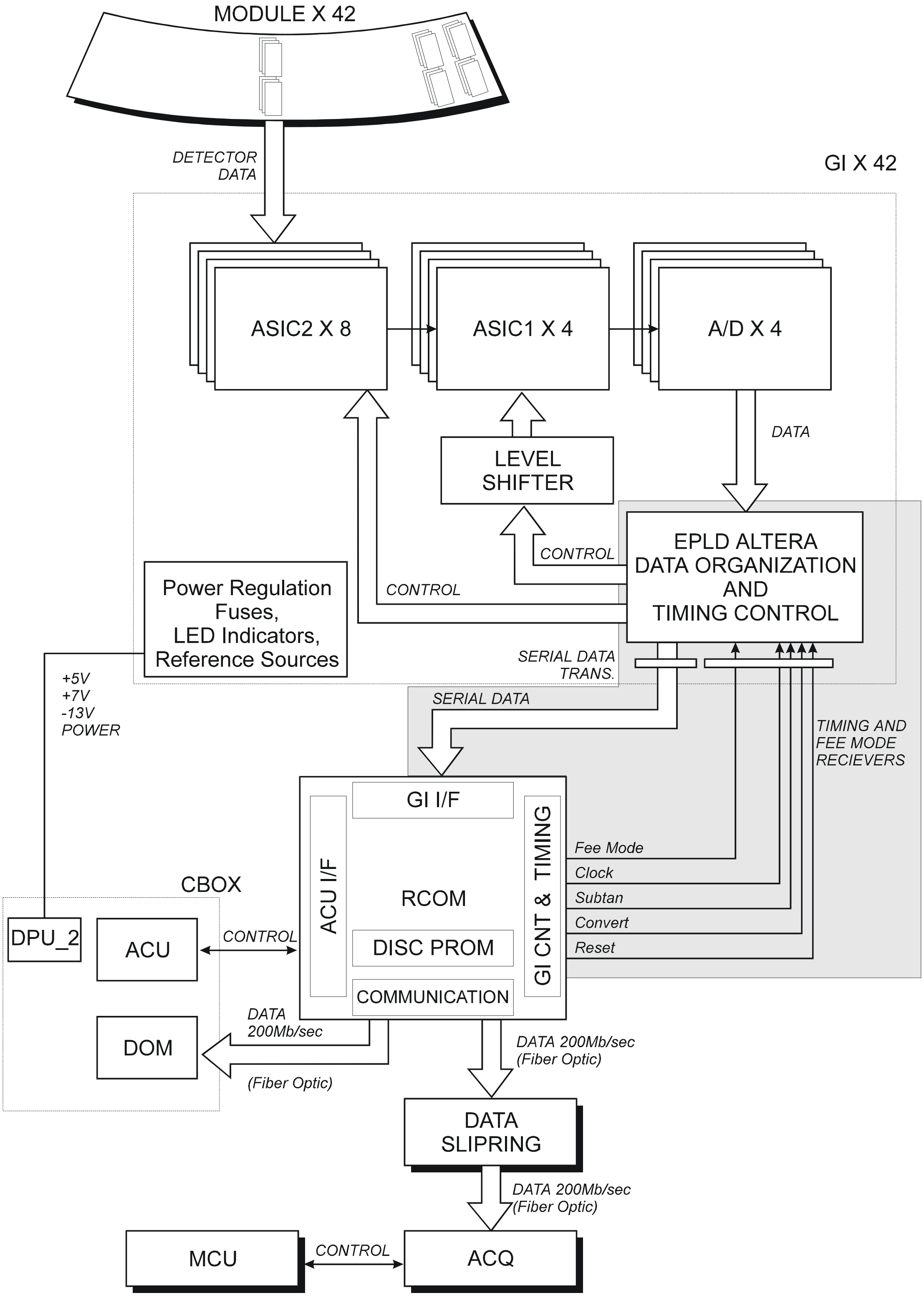

MODULE X 42
DETECTOR DATA
GI X 42
ASIC2 X 8
ASIC1 X 4
A/D X 4
DATA
LEVEL SHIFTER
EPLD ALTERA DATA ORGANIZATION AND TIMING CONTROL
CONTROL
CONTROL
Power Regulation Fuses, LED Indicators, Reference Sources
SERIAL DATA TRANS.
SERIAL DATA
TIMING AND FEE MODE RECIEVERS
+5V
+7V
-13V
POWER
GI I/F
ACU I/F
RCOM
GI CNT & TIMING
DISC PROM
COMMUNICATION
Fee Mode
Clock
Subtan
Convert
Reset
CBOX
DPU_2
ACU
CONTROL
DOM
DATA 200Mb/sec
(Fiber Optic)
DATA 200Mb/sec (Fiber Optic)
DATA SLIPRING
DATA 200Mb/sec (Fiber Optic)
MCU
CONTROL
ACQ

Figure 3-108: GI Card Control and Timing

GI Card Output Data

Serial output data is comprised of the following:

- 64 channels assigned to four slice data output signals, with16 bits per channel. Every word of 16 bits consists of two leading bits (range bits) and 14 bits of data generated by the A/D converter, which is led by the MSB bit.
- FEE mode data in 16 bits, with D0 the leading bit. This output can be checked by the RCOM card and is used for the handshake.
- Three bits of error and parity information. These bits are also used for checking and correcting communication errors.

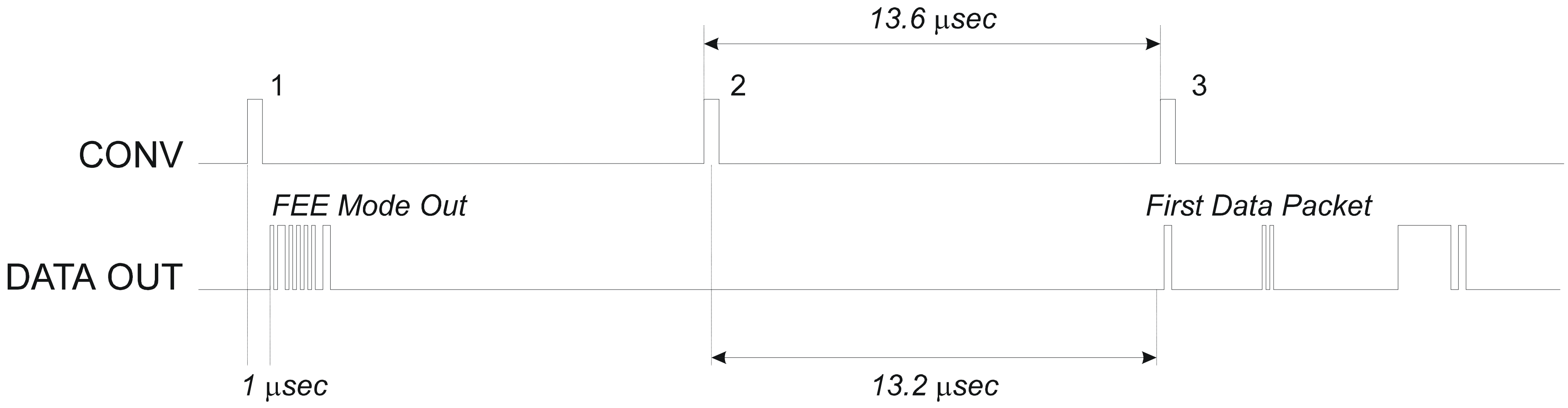


Figure 3-109: Data Out Transmission

GI Card Control Signals

FEE Mode

All GI parameters are controlled via the EPLD component. EPLD is fed from synchronized serial data generated from the RCOM card. FEE mode data is sent every **subfan** 600 ns after the rising edge. The data is composed of two bytes of 8 bits, as shown below.

D0	D1	D2	D3	D4	D5	D6	D7
Slice Select 0	Slice Select 1	Slice Select 2	Range 0	Range 1	Gain A, B, 0	Gain A, B, 1	Gain C, D, 0

D8	D9	D10	D11	D12	D13	D14	D15
Gain C, D, 0	Capacitor 0	Capacitor 1	Input Select 0	Input Select 1	Output Select 0	Output Select 1	Ultra Low Enable

Clock A 5 MHz clock is the main clock connected to EPLD. All input and output signals are synchronized to the rising edge of this clock.

Subfan The **subfan** signal indicates the integration time of the GIs. This time changes according to the scan mode rotation speed and sampling density. The shortest time indicated by **subfan** is 323 µsec.

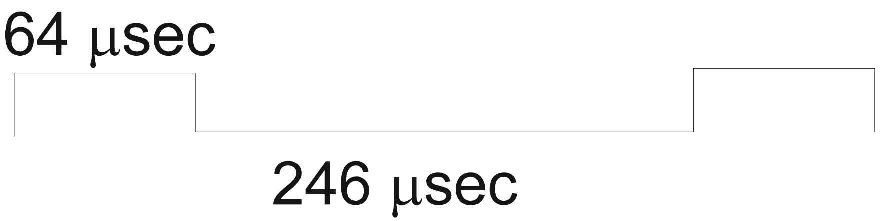


Table 3-1. Cycle Times of the subfan Signal

SCAN SPEED	TIME
0.5 sec	431 µsec ± 2%
0.75 sec	323 µsec ± 2%, 646 µsec ± 2%
1 sec	431 µsec ± 2%
1.5 sec	323 µsec ± 2%, 646 µsec± 2%
2 sec	431 µsec ± 2%
Surview	431 µsec ± 2%

Strcnvt	This convert signal transfers control information. It is generated 18 times by the RCOM card during the interval specified by the **subfan** signal. The first pulse causes all GI cards to start transmitting FEE mode data. The next 16 pulses trigger the transmission of 16 groups, each group containing four channels (a total of 64 channels). The last pulse prepares the EPLD for the next **subfan** signal.
Reset	This reload signal also contains control information. It is sent by the RCOM card and is used if the GI EPLD software crashes to reload the GI EPLD from its PROM.

GI Diagnostics

Gain (Analog) Test

This test uses the internal current source instead of the detector current. The source current is 5 nA, 50 nA, 2 μA. The data should be in a specified data range.

Assignment Test

Produces the synthetic data, which is different for each detector channel. It is built in the following format:

MSB 15:	Complement of FEE mode bit 4 (MSB of range)
Bit 14:	Complement of FEE mode bit 3 (LSB of range)
Bit 13:	“0”
Bit 12:	“0”
Bit 11, 10:	Slice number (0-3)
Bit 9-4	Gi card number (0-41)
Bit 3-0:	Complement of channel number in the slice (0-15)

The data sent from all 42 GI cards looks as follows when the range equals 1,1.

```
GI # 0     00 00 00 000000 1111
           00 00 00 000000 1110
           00 00 00 000000 1101
           .
           .
           00 00 00 000000 0000
           00 00 01 000000 1111
           00 00 01 000000 1110
           .
           .
           00 00 11 000001 0000
GI # 1     00 00 00 000001 1111
           00 00 00 000001 1110
           .
           .
           00 00 11 000001 0000
           .
           .
GI # 41    00 00 00 101010 1111
           .
           .
           00 00 11 101010 0000
```

LEDs

The following three LEDs are on the GI card:

- 5 VDC
- 7 VDC
- -12 VDC

Fuses

0.75A (PN F501050750A)

RCOM Card

The RCOM is controlled by the ACU. The ACU transfers the scan parameters and the mode of operation to the RCOM.

Overview

The main tasks of the RCOM board are:

- Receiving four rows of 672 detectors per slice from 42 GI boards during each **subfan**.
- Organizing the detector’s values in four frames.
- Arranging the detector data in each frame (slice) in the same order as the detector order on the machine.
- Adding the header to each frame (slice) with relevant data.
- Serializing the frame data, encoding it and transmitting it through an optical transmitter to the ACQ and the DOM.
- Generating the GI timing and mode.
- Implementing the resend mechanism with the ACQ board.
- Receiving temperature measurement from the temperature sensors on the DMS and writing the values into the Frame Header and in the RCOM registers for the ACU.
- Controlling a sequence of CDRH/BIAS measurements before each scan and after setting the scan parameters.
- Generating a disk pattern for diagnostics.

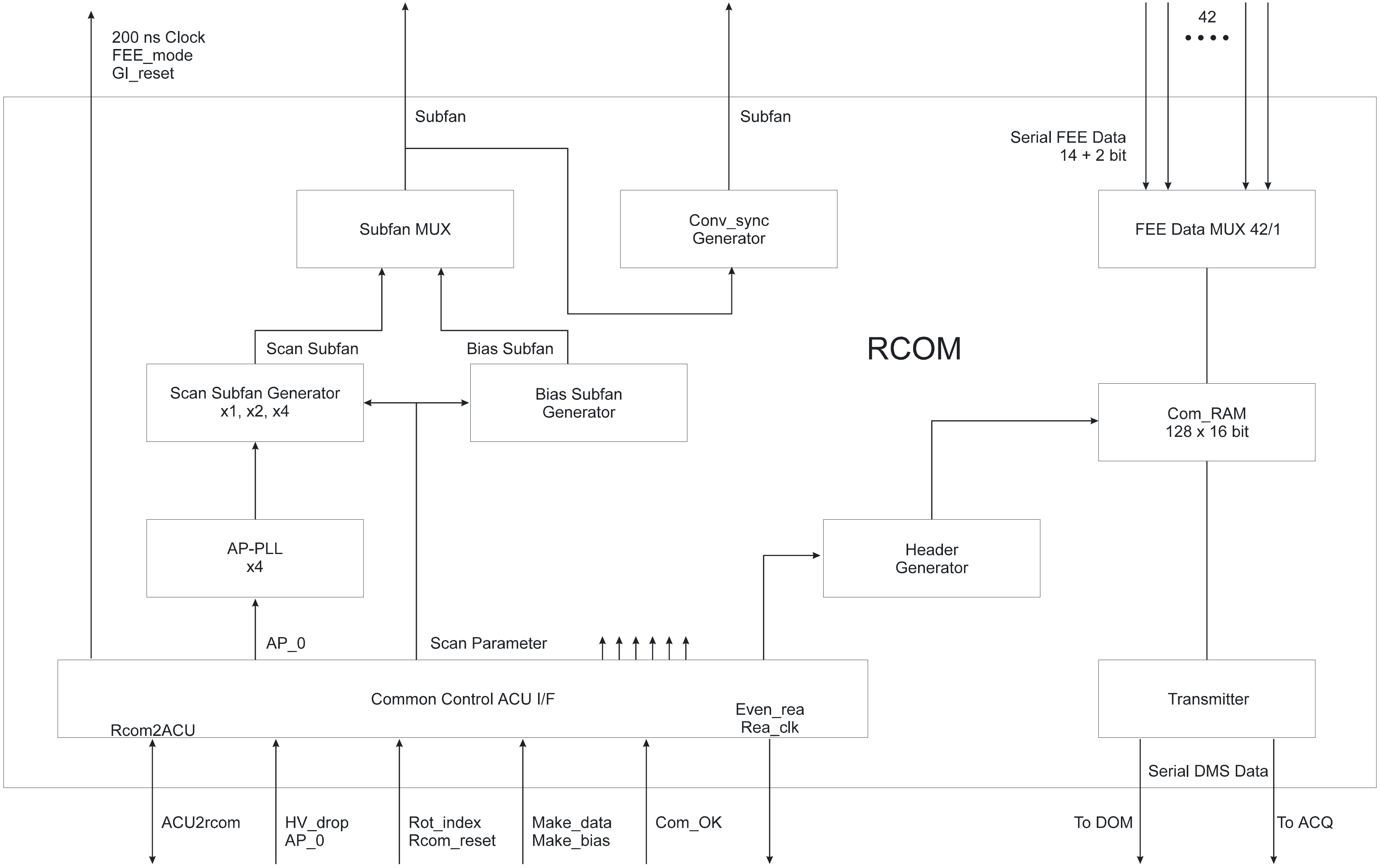

200 ns Clock
FEE_mode
GI_reset
Subfan
Subfan
42
Serial FEE Data
14 + 2 bit
Subfan MUX
Conv_sync
Generator
FEE Data MUX 42/1
Scan Subfan
Bias Subfan
RCOM
Scan Subfan Generator
x1, x2, x4
Bias Subfan
Generator
Com_RAM
128 x 16 bit
AP-PLL
x4
Header
Generator
AP_0
Scan Parameter
Common Control ACU I/F
Rcom2ACU
Even_rea
Rea_clk
Transmitter
Serial DMS Data
ACU2rcom
HV_drop
AP_0
Rot_index
Rcom_reset
Make_data
Make_bias
Com_OK
To DOM
To ACQ

Figure 3-110: RCOM Card Block Diagram

RCOM Card Connection

FEE to RCOM

A single serial line connects each GI card (18 frames) as follows:

- The first frame is the FEE mode.
- The next 16 frames contain the FEE data.
- The last frame has an additional bit that reports any errors while reading the FEE mode and FEE data. RCOM checks the FEE mode error bit and the parity bit in all of the GI cards.

The RCOM card receives the measured data from the GI cards (a single line from each GI). The detector data of all 42 lines are converted to parallel format of 16 bits and stored into a memory buffer of 128 KW.

- The detector values received during one time period defined by the **subfan** signal are stored in four frames (frame = slice). The reordering of the detector data is done during the process of writing into the memory buffer.
- A header is added to each frame with relevant information.
- Generates the main clock, synchronization signals and control signals.
- All lines are differential.

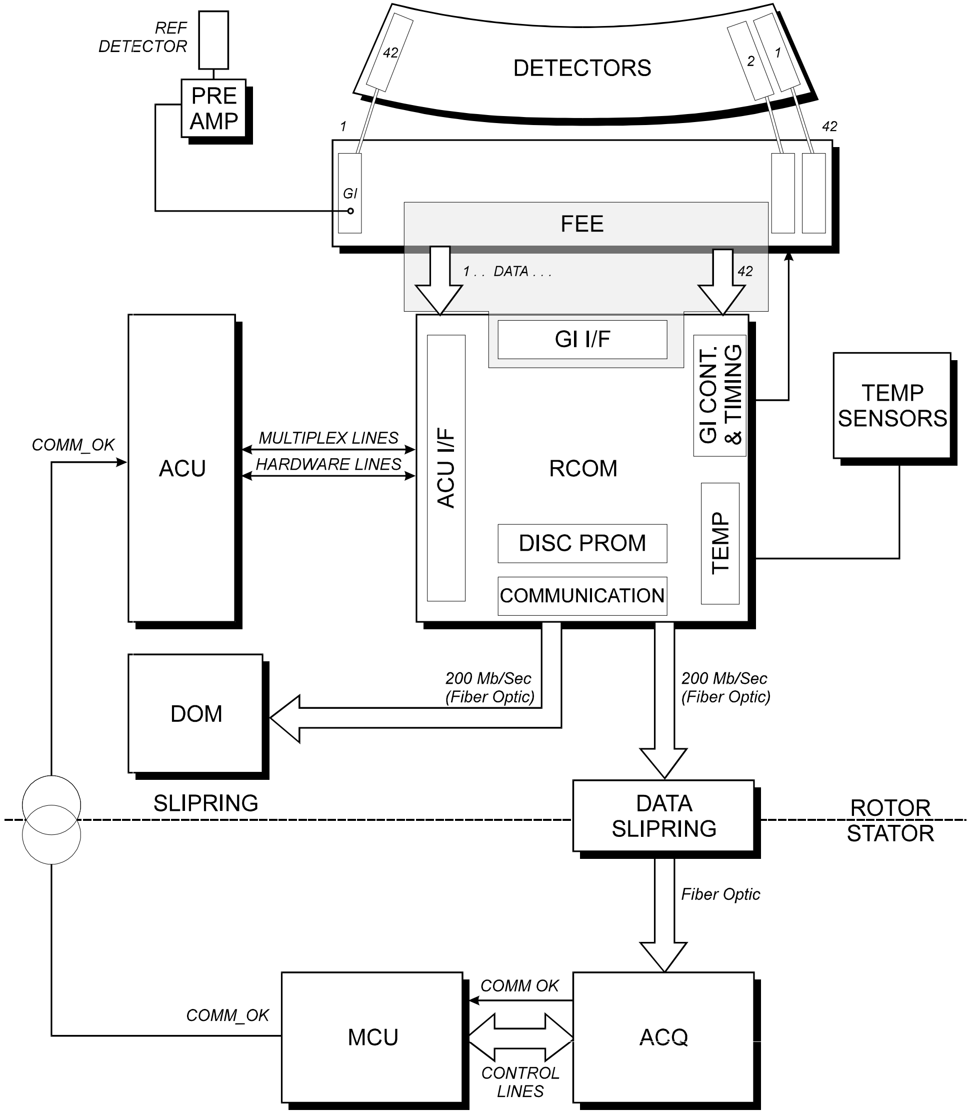

REF DETECTOR
PRE AMP
DETECTORS
42
2
1
1
42
GI
FEE
1 . . DATA . . .
42
GI I/F
GI CONT. & TIMING
TEMP SENSORS
ACU
COMM_OK
MULTIPLEX LINES
HARDWARE LINES
ACU I/F
RCOM
DISC PROM
COMMUNICATION
TEMP
DOM
200 Mb/Sec (Fiber Optic)
200 Mb/Sec (Fiber Optic)
SLIPRING
DATA SLIPRING
ROTOR
STATOR
Fiber Optic
COMM OK
COMM_OK
MCU
ACQ
CONTROL LINES

Figure 3-111: RCOM Card Connection

Communication (Frame Data)

The task of the communication block is to read the frame from the memory buffer and write it to the Hot link chip. The data is serialized, encoded (8 to 10 bits) and transmitted to the Acquisitor board. The transmission rate is 200 Mbps. The same data is sent to the DOM.

The following is the frame structure:

Start command 1 word	Header sector 16 words	Detectors sector 672 words	CRC 1 word	Tail command 1 word

Table 3-30: Frame Information

WORD #	DATA FROM RCOM TO ACQ (WORDS)	WORD #	DATA FROM RCOM TO ACQ (WORDS)
1	DMS Status	12	Reading # (frame #) High
2	DMS Errors	13	Table Position
3	FEE mode	14	0
4	HW lines	15	Rotation Angle
5	GI_NOK lines	16	0
6	Detector Temperature	17	Channel 0
7	Integration time		Channel 1
8	0		Channel 2
9	Scan # + Slice #		
10	0		...
11	Reading # (frame #) Low	688	Channel 671

The Resend mechanism is implemented between the RCOM and ACQ card.

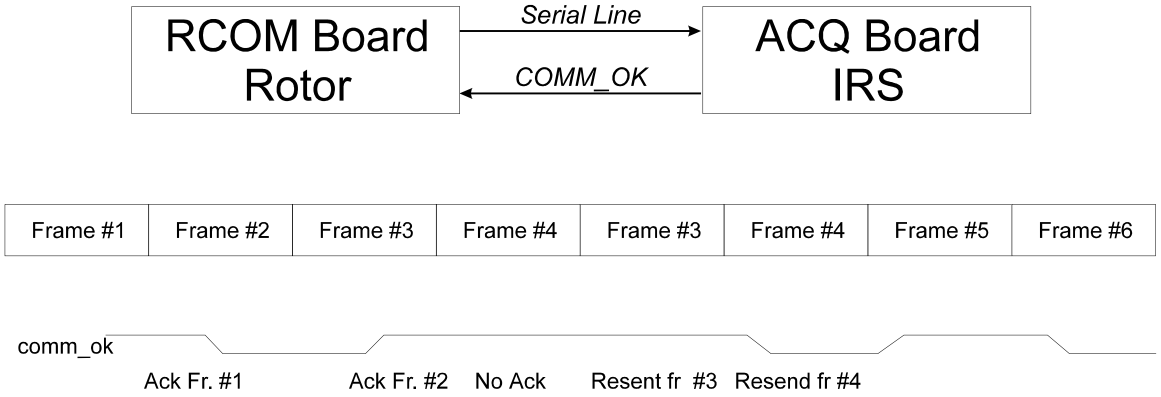

RCOM Board
Rotor
Serial Line
COMM_OK
ACQ Board
IRS
Frame #1
Frame #2
Frame #3
Frame #4
Frame #3
Frame #4
Frame #5
Frame #6
comm_ok
Ack Fr. #1
Ack Fr. #2
No Ack
Resent fr #3
Resend fr #4

Figure 3-112: Relation Between Frames and comm_ok Line

Frames are transmitted on the serial line. The frames are checked in the ACQ card for CRC errors. The COMM_OK line is used by the ACQ card to inform the RCOM card about the quality of reception. The acknowledgment is done by the transition of levels of COMM_OK signal.

RCOM to FEE

The RCOM cards sends the following signals to the FEE:

- 200 ns clock
- **subfan** signal
- Convert signal
- FEE mode serial signal
- GI **Reset**

Clock A 5 MHz clock

subfan This signal indicates the integration time to the GI cards. Its period changes according to the sampling density and rotation speed.

Table 3-31: Cycle Times of the subfan Signal

Scan speed 0.5 sec	431 µsec ± 2%
Scan speed 0.75 sec	323 µsec ± 2%, 646 µsec ± 2%
Scan speed 1 sec	431 µsec ± 2%
Scan speed 1.5 sec	323 µsec ± 2%, 646 µsec± 2%
Scan speed 2 sec	431 µsec ± 2%
Surview	431 µsec ± 2%

The RCOM generates two **subfan** signals:

- Scan **subfan -** generated from the AP pulses. The number of **subfan** readings is as follows:
  - — Normal Sampling1160 per revolution
  - — High Sampling2320 per revolution
  - — Very High Sampling4640 per revolution

- BIAS **subfan -** generated by internal generator.
  Two time intervals are used: DT1 and DT2. DT2 = 2 × DT1. DT1 is set according to the desired scan **subfan** signal.

The Convert Signal

The GI card uses the convert signal to generate the conversion timing and serial data transfer to the RCOM. There are 18 pulses with 13.6 µsec between two convert signals.

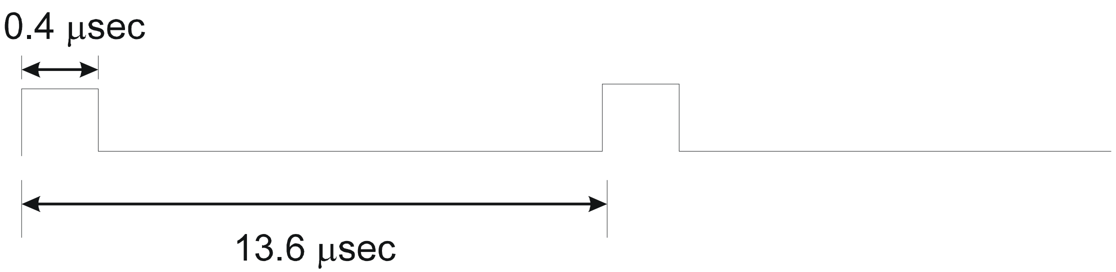


Figure 3-113: Convert Signal

FEE Mode The FEE mode signal is a 16 bit word that controls the operation of the FEE. It is received from the ACU and sent to the GI cards.

D0	D1	D2	D3	D4	D5	D6	D7
Slice Select 0	Slice Select 1	Slice Select 2	Range 0	Range 1	Gain A, B, 0	Gain A, B, 1	Gain C, D, 0

D8	D9	D10	D11	D12	D13	D14	D15
Gain C, D, 0	Capacitor 0	Capacitor 1	Input Select 0	Input Select 1	Output Select 0	Output Select 1	Ultra Low Enable

GI Reset Signal

This signal resets the GI card and reloads the ALTERA. It is sent under the following conditions:

- Power up
- ACU to RCOM hardware line reset
- ACU to RCOM GI reset through multiplexed line

ACU I/F

This block is used to receive the scan parameters and control lines and return status.

All interface lines are optically isolated. The signals between the ACU and RCOM are separated into two groups:

- Realtime signals (see *Table 3-32*)
- Multiplexed signals - All signals are packed into two serial lines, one from ACU to RCOM (**acu2rcom**), another one from RCOM to ACU (**rcom2acu**).

Table 3-32: Realtime signals

SIGNAL NAME	DIRECTION	FUNCTION
rcom_reset	ACU to RCOM	Reset to Rcomm board
make_bias	ACU to RCOM	Indication the process of taking bias measurements
make_data	ACU to RCOM	Indication of taking data measurements (scan)
hv_drop	ACU to RCOM	The x-ray signal measured from HV generator has dropped below a limit.
rot_index	ACU to RCOM	Index pulse from code wheel
ap	ACU to RCOM	Angular pulses from code wheel
com_ok	ACU to RCOM	Acknowledge signal from Acquisitor board, indicating good reception of last frame
even_rea	RCOM to ACU	Selecting one of the two focal spots, low=0 for first reading
rea_clk	RCOM to ACU	One pulse per **subfan**, Tp> 10ms

Table 3-33: Multiplexed Signals

SIGNAL NAME	PART OF	FUNCTION
htp	acu2rcom	Horizontal table pulses
XC	acu2rcom	ENABLE signal for x-ray (comes from MCU)
xray	acu2rcom	X-Ray on indication
par_reset	acu2rcom	Not in use
strobe	acu2rcom	Handshake signal - data and address are valid
read/_write	acu2rcom	Handshake signal - read/write from/to RCOM
htp_up	acu2rcom	HTP count direction
speed_ok	acu2rcom	Rotation speed is OK
rcom_ok	rcom2acu	RCOMM board is functioning. Comm. with ACU
ack	rcom2acu	Handshake signal - acknowledge to strobe signal
request	rcom2acu	RCOMM requests a read operation from ACU
test_run	rcom2acu	TBD

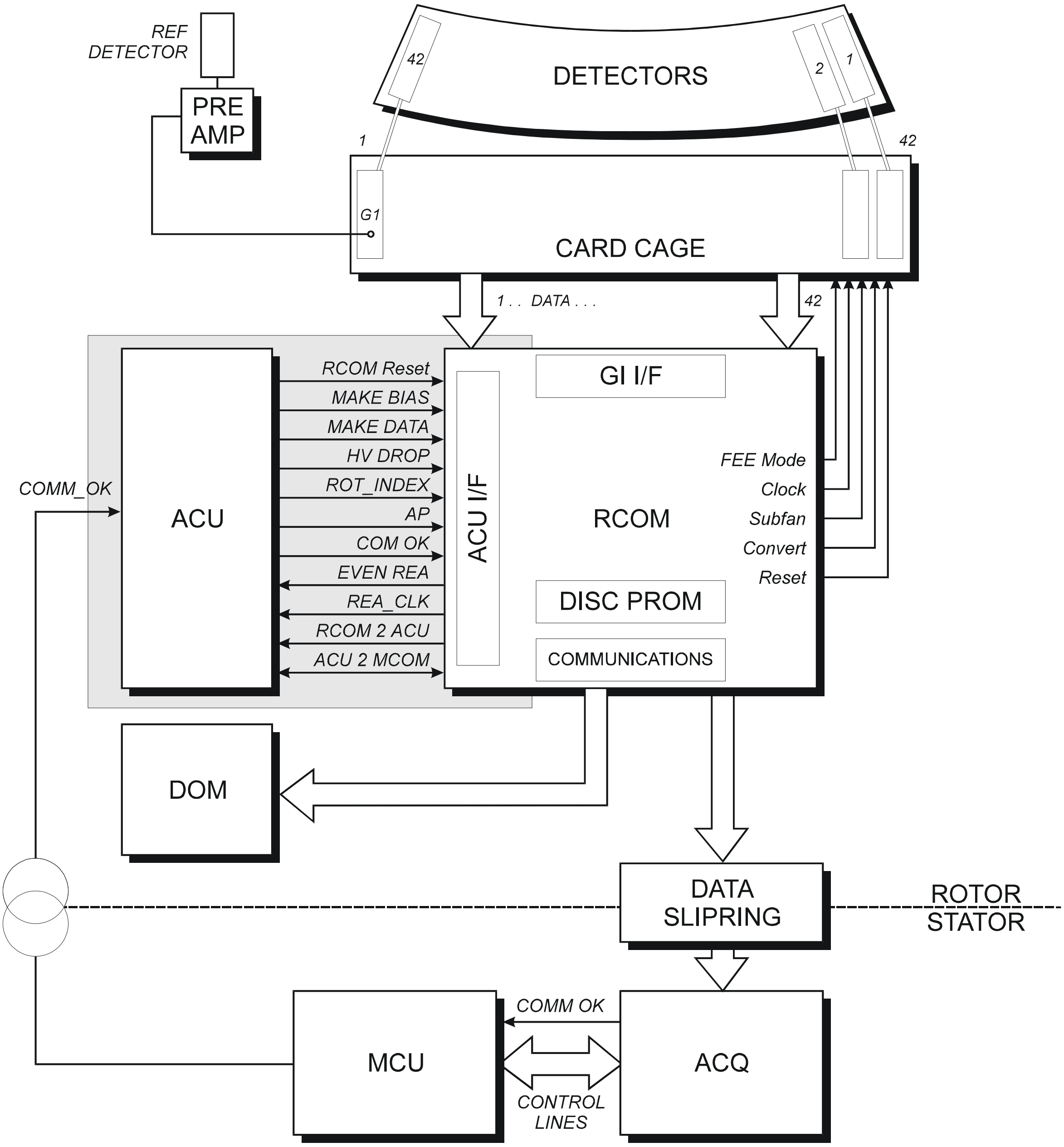

REF DETECTOR
PRE AMP
DETECTORS
42
2
1
1
42
G1
CARD CAGE
1 . . DATA . . .
42
ACU
RCOM Reset
MAKE BIAS
MAKE DATA
HV DROP
ROT_INDEX
AP
COM OK
EVEN REA
REA_CLK
RCOM 2 ACU
ACU 2 MCOM
COMM_OK
ACU I/F
GI I/F
RCOM
FEE Mode
Clock
Subfan
Convert
Reset
DISC PROM
COMMUNICATIONS
DOM
DATA SLIPRING
ROTOR
STATOR
MCU
COMM OK
CONTROL LINES
ACQ

Figure 3-114: RCOM Card ACU Interface

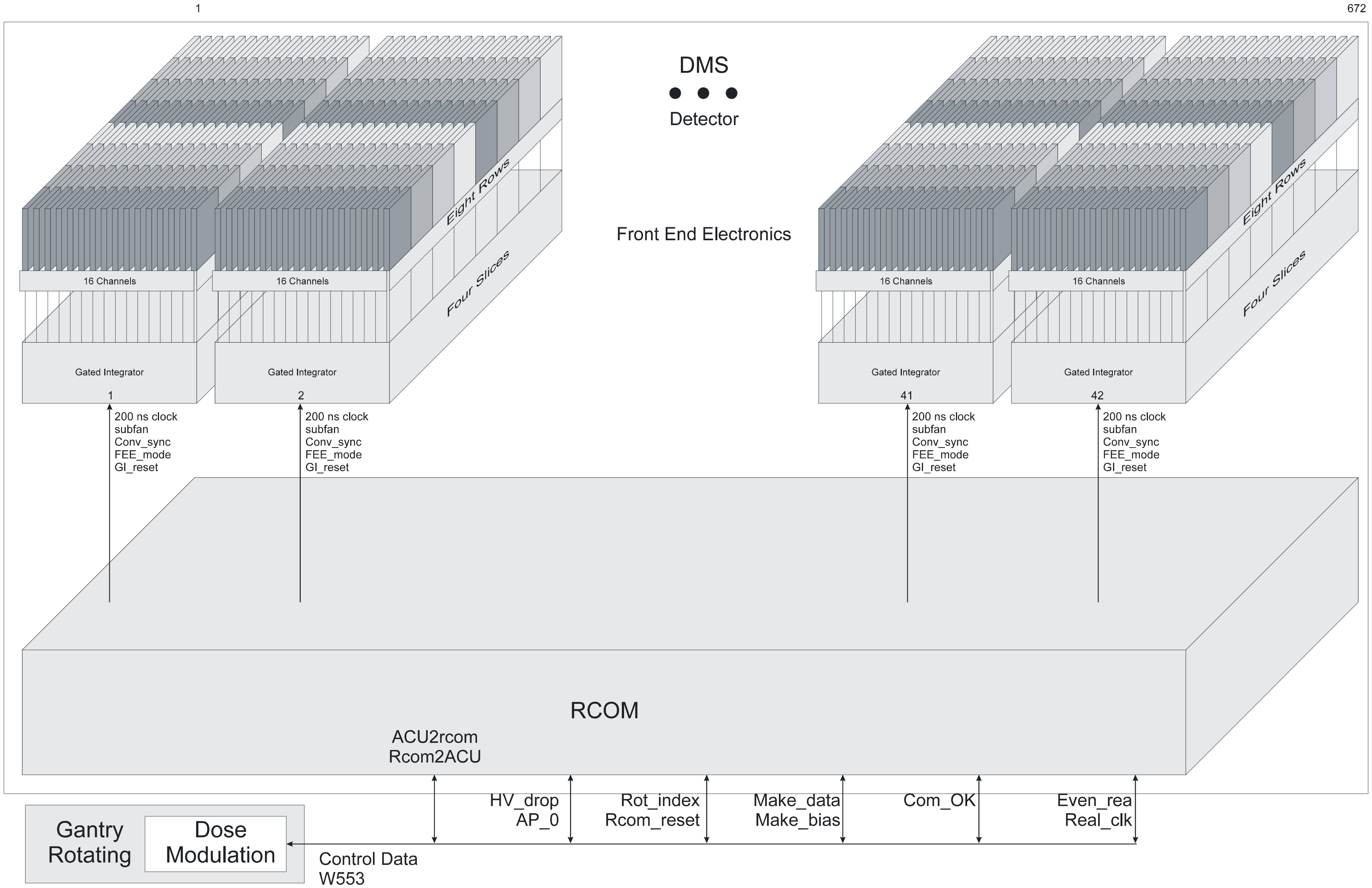

1
672
DMS
● ● ●
Detector
Front End Electronics
Eight Rows
Four Slices
16 Channels
16 Channels
16 Channels
16 Channels
Gated Integrator
Gated Integrator
Gated Integrator
Gated Integrator
1
2
41
42
200 ns clock
subfan
Conv_sync
FEE_mode
GI_reset
RCOM
ACU2rcom
Rcom2ACU
HV_drop
AP_0
Rot_index
Rcom_reset
Make_data
Make_bias
Com_OK
Even_rea
Real_clk
Gantry
Rotating
Dose
Modulation
Control Data
W553

Figure 3-115: DMS Control Signals

Temperature Interface

There are three temperature sensors located as follows:

- Cradle Temp Sensor #3 measures the detector temperature. This temperature is sent to the IRS with each frame in the header.
- The **two** sensors on the GI crate cover measure the temperature of the GI crate. The ACU reads the temperature of the two sensors through multiplex line RCOM2ACU. The purpose of these sensors is to generate a warning message if one of the fans does not function.

The three sensors are connected to the RCOM card. Each is identified by an address defined with a dipswitch on the sensor board.

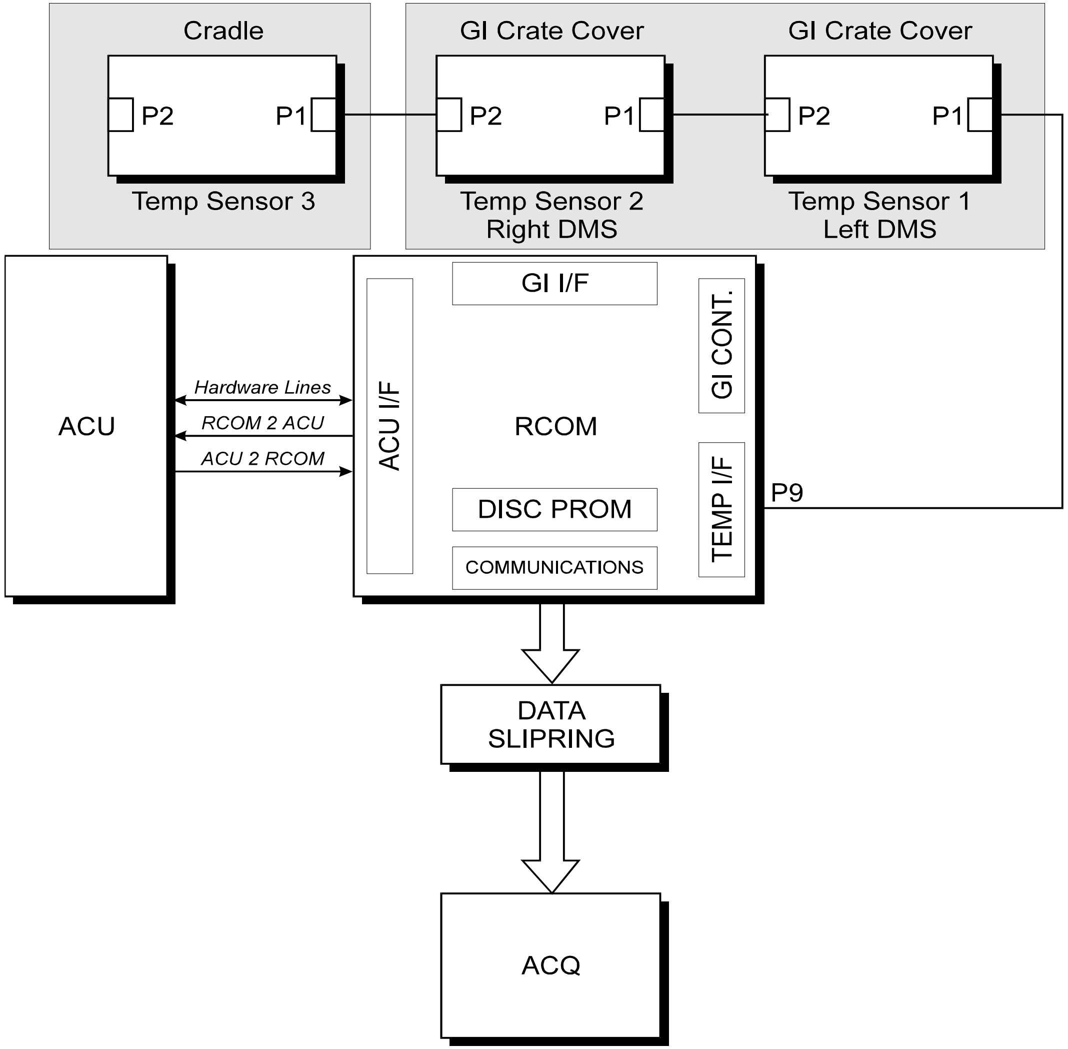

Cradle
GI Crate Cover
GI Crate Cover
P2
P1
P2
P1
P2
P1
Temp Sensor 3
Temp Sensor 2
Right DMS
Temp Sensor 1
Left DMS
ACU
Hardware Lines
RCOM 2 ACU
ACU 2 RCOM
ACU I/F
GI I/F
RCOM
DISC PROM
COMMUNICATIONS
GI CONT.
TEMP I/F
P9
DATA
SLIPRING
ACQ

Figure 3-116: Temperature Control

The following lines connect the temperature sensors and RCOM:

- **Data**: Serial line for Read/Write of the sensor by the RCOM
- **Clock**: 9 ns
- **Supply 5V:** 5VDC from RCOM
- **GND:** GND from RCOM

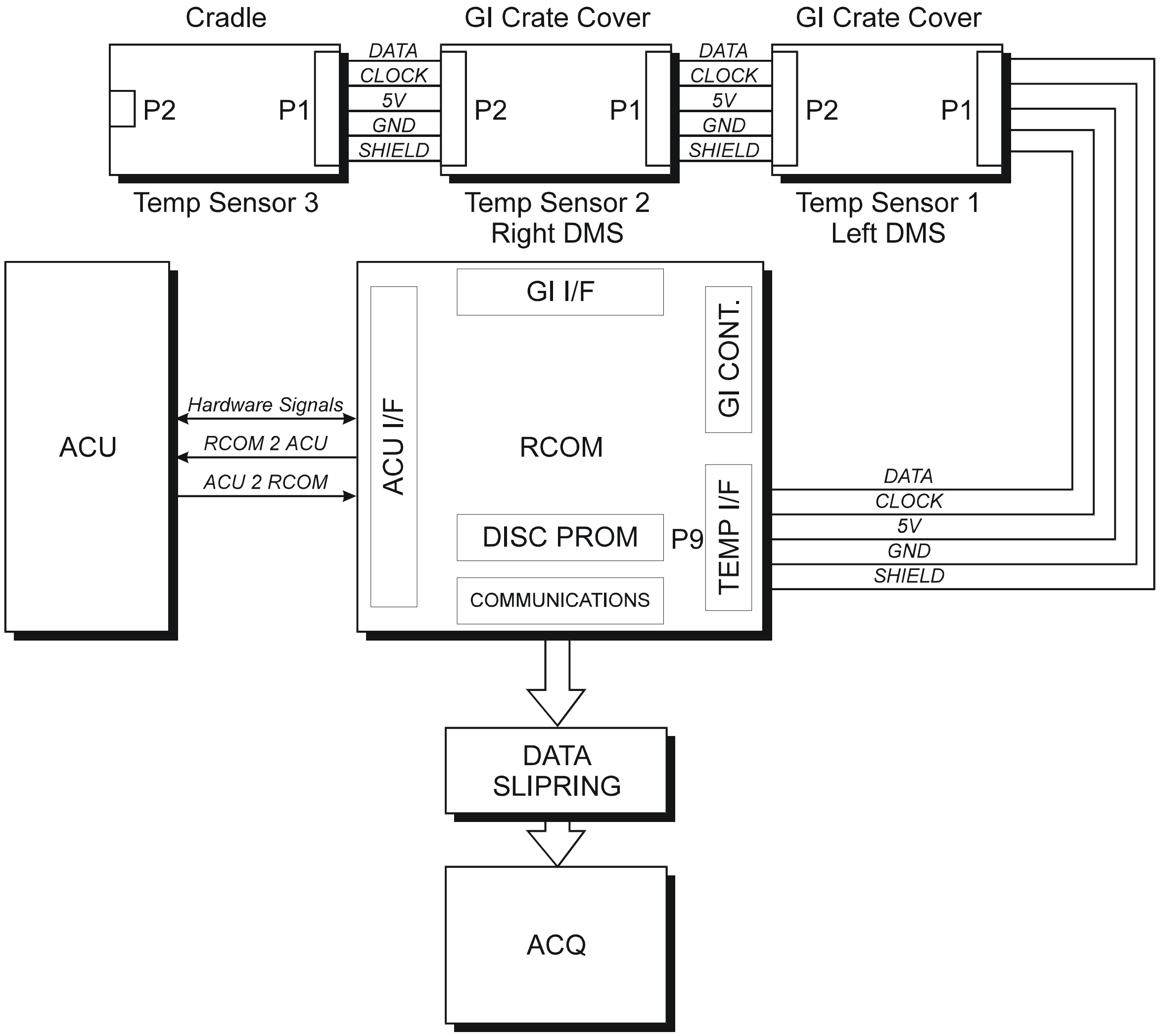

Cradle
GI Crate Cover
GI Crate Cover
P2
P1
P2
P1
P2
P1
DATA
CLOCK
5V
GND
SHIELD
Temp Sensor 3
Temp Sensor 2
Right DMS
Temp Sensor 1
Left DMS
ACU
Hardware Signals
RCOM 2 ACU
ACU 2 RCOM
ACU I/F
GI I/F
GI CONT.
RCOM
TEMP I/F
DISC PROM
P9
COMMUNICATIONS
DATA
SLIPRING
ACQ

Figure 3-117: Temperature Control Signals

RCOM Diagnostics

DISC PROM

Testing the RCOM board, without the GI interface detector values placed in a PROM, are used to generate the transmitted frames to the ACQ. The scan process may be executed and the raw data may be reconstructed.

BIAS and CDRH

This test checks the DMS and communication from the detectors to the ACQ and verifies that it is ready to scan. It satisfies the FDA safety requirements and ensures that data can be received and used before radiation is applied. The BIAS and CDRH test also checks the data path of all the units from the GI to the IRS.

The checks include:

- BIAS measurements
- GI Gain (analog) test
- Assignment test

The BIAS and CDRH test is controlled by the RCOM card and the data is checked by the IRS (ACQ).

The BIAS readings are used for two purposes:

- To subtract the detector offset in the reconstruction process.
- For the CDRH test. The data is checked that it is within predefined values.

In BIAS measurement mode, the range is defined by RCOM. To reduce the noise, each reading is repeated several times and averaged by the ACQ.

Pattern Test

This test tests the media between the RCOM and the ACQ card. The host selects the four options of pattern testing through the ACU. In this test, predefined frames are generated in the RCOM and checked in the ACQ card.

One of four options can be set without software by using the dip switches in the front panel according to *Table 3-34*.

Table 3-34:

S1	0 - RCOM Nominal Operation 1 - Diagnostic operation. Pattern defined by SW (4.3)
S2	0 - Frames without errors 1 - Errors are injected. One error per few seconds.
S(4.3)	00 - 0, 1, 2.. Incremental 01 - Walking one 10 - Walking zero 11 - 55AAh Constant

ACU Interface Test

The host writes and reads the RCOM registers through the ACU and checks the expected values.

Scan without ACU Test

Tests the RCOM without the ACU timing. Executes the scan using the internal generation of **subfan**. The detector values are taken from the GI assignment test.

Scan with Assignment Test

This is an assignment test with an internal timing test. In this test, all of the board is tested. The diagnostic software on the ACQ board should check the incoming frames in the ACQ public memory.

Resend Mechanism Test

This scan is done with the PROM selected. The error is injected in the frame. The diagnostics software on the ACQ should check the frame.

LEDs

VCC - 5 Volt	Power voltage of the card
CONF_DONE	ON when configuration of FPGAs (ALTERA chips) is done.
ACU_COM_OK	ON when the serial line from ACU is received properly.
RESEND	ON when a frame is re-transmitted.
GI_COM	ON when the communication with the GI cards is working well.
DIAGNOSTIC	ON when switches S[2..1] are not in zero position.
MAKE_BIAS	ON indicates bias process.
MAKE_DATA	ON indicates scan process.
AP	ON when receiving angular pulses from code wheel.
HTP	ON when receiving horizontal table pulses.
Fuses	5A (PN F5015005A)

DMS Temperature Control Cards

DMS OFF Control Card

The DMS OFF control board controls the DMS temperature when the system is turned OFF as follows (see also *Figure 3-118*):

- **Mains_1 -** 230 VAC from PDC switched ON and OFF by the console
- **Mains_2 -** 230 VAC is always ON. It comes from the PDC.
- **S1 -** Closed if K1 is inactive (**Mains_1** does not exist)
- **S2 -** Closed if temperature > 35°. Open when temperature < 25°
- **DPU_1 -** Supplies the DC voltage to the CBOX and to the DMS OFF control card
- **DPU_2 -** Supplies the DC voltage to the DMS. **DPU_2** is off if **S1** and **S2** are closed

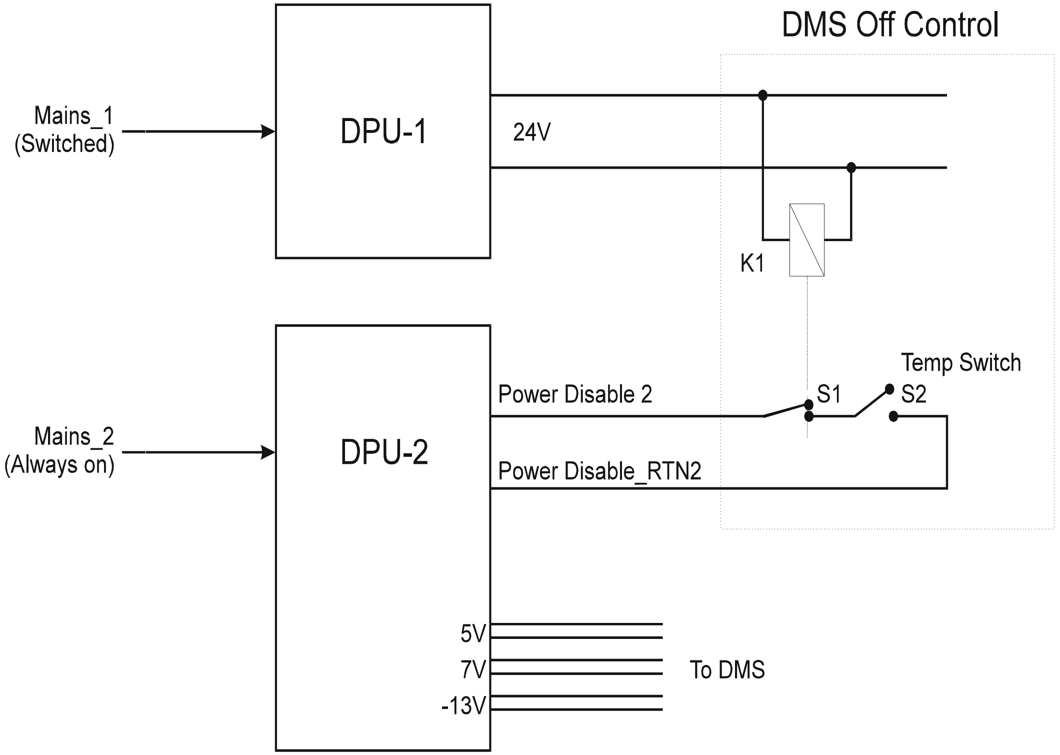

DMS Off Control
Mains_1
(Switched)
DPU-1
24V
K1
Mains_2
(Always on)
DPU-2
Power Disable 2
S1
Temp Switch
S2
Power Disable_RTN2
5V
7V
-13V
To DMS

Figure 3-118: DMS OFF Control Board

Power Distribution Card

The 24 VDC power from **DPU_2** is reduced to 16 VDC for the FEE fans to reduce the noise of the fans.

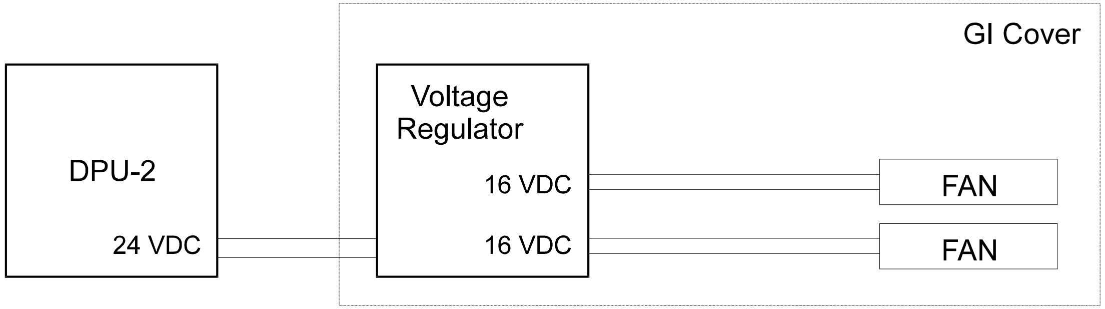

GI Cover
DPU-2
24 VDC
Voltage Regulator
16 VDC
16 VDC
FAN
FAN

Figure 3-119: Power Distribution Card

Lower Beam

Overview

The lower beam shapes the X-ray beam in the CT scanners geometrically with the following components:

- **P-Plane collimator (detector diaphragm)** - A variable width slit collimator installed below the patient aperture. It matches the beam thickness to the detection array, according to the required slice thickness. The P-Plane collimator is monitored by the DELPHI board in the C-Box.
- **Ultra-High Resolution (UHR) collimator** - This collimator may be moved IN and OUT of the beam in front of the detectors. The UHR collimator includes slit holes in the Z direction which mask some of the detector’s effective areas and converts the detectors effectively to thinner detectors. The UHR collimator covers a field of view only up to 250 mm. It is controlled by the ZCON board in the C-Box.

These assemblies are installed on the rotor in the general area of the slice plane in the space between the aperture and the detection array. They are included in the DMS major assembly.

P-Plane Collimator (Detector Diaphragm)

The block diagram in *Figure 3-120* shows the hardware of the P-Plane collimator control circuit which consists of the following:

- **DELPHI -** Hardware positioning circuit, power stages logic circuit.
- **DMS** - P-plane collimator assembly
- **M1** - DC motor for position the p-plane collimator
- **E1** - Positioning Encoder

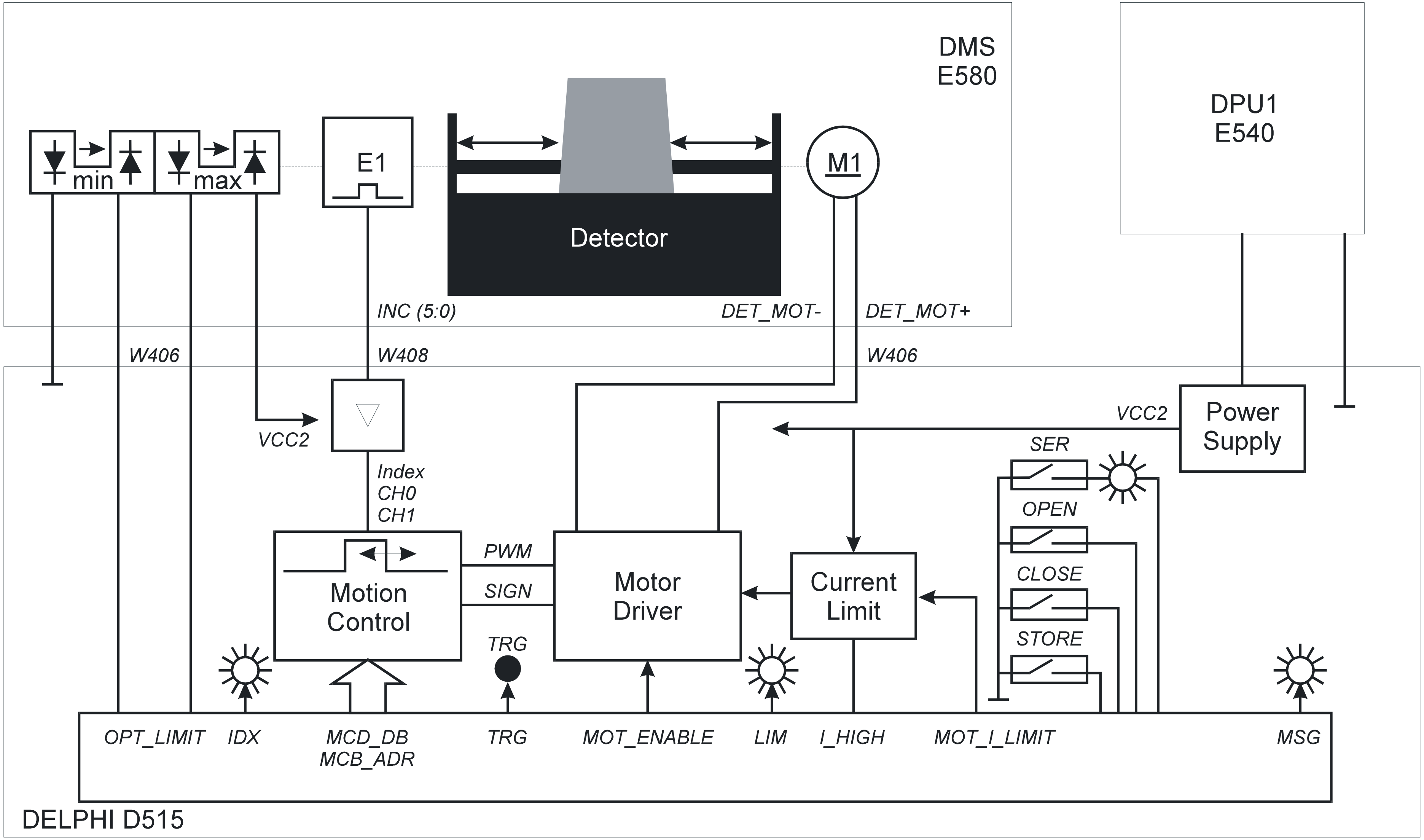

DMS
E580
min
max
E1
Detector
M1
DPU1
E540
INC (5:0)
DET_MOT-
DET_MOT+
W406
W408
W406
VCC2
Index
CH0
CH1
VCC2
Power
Supply
SER
OPEN
CLOSE
STORE
PWM
SIGN
Motion
Control
Motor
Driver
Current
Limit
TRG
OPT_LIMIT
IDX
MCD_DB
MCB_ADR
TRG
MOT_ENABLE
LIM
I_HIGH
MOT_I_LIMIT
MSG
DELPHI D515

Figure 3-120: P-Plane (Detector Diaphragm) Block Diagram

Actual P-Plane Collimator Position

A positioning encoder (E1) on the DMS provides feedback about the actual p-plane collimator position. The encoder outputs the following signals to the DELPHI:

- **CH0_POS/NEG -** Increment Pulse 0°
- **CH90_POS/NEG -** Increment Pulse 90°
- **INDEX_POS/NEG -** Index Pulse

All three signals are processed by the motion control circuit. This circuit has an internal actual position counter which is incremented or decremented by the **CH090** signals. The index pulse is set if the p-plane is at the reference aperture.

Nominal P-Plane Collimator Position

The nominal P-Plane position **MCB_DB** is sent to the motion control circuit by the MCBD. This value corresponds to the selected slice thickness.

P-Plane Positioning

The motion control circuit compares the **MCB_DB** value with its internal actual positioning counter. According to the difference, it sets the signal sign, which connects a 24 V pulse width modulated voltage to the M1 motor. The motor rotates clockwise or counterclockwise, thus changing the P-Plane aperture. The motion control stops the motor if the contents of the internal actual position counter is equal to the **MCB_DB** data.

Current Limit

The current limit has two possible values. The higher value is set in the beginning of the motor movement. After a defined time, it is set to the lower value.

Optical Limit Switch

The optical limit switches prevent mechanical collision of the P-Plane collimator. They stop the P-Plane collimator movement at minimum and maximum aperture.

Service Switches

- Service - Selects service operation
- Open - Opens the p-plane collimator
- Close - Closes the p-plane collimator
- Store

LEDs

- **Index** - Displays encoder index pulse
- **LIM** - Indicates when the limit switch is active
- **MSG -** During adjustment, accepts the store position
- **Service** - Indicates service mode

Power Supply

The 24 VDC of the motor M1 is provided by VCC2 via **DPU_1 P_24V**.

MCB D2

The function of the p-plane collimator circuit is controlled and monitored by the processor located on D2 (Master Control Board). Communication between the processor and the Mx8000 system is via the CAN bus.

Ultra High Resolution (UHR) Collimator

The block diagram in *Figure 3-121* shows the hardware of the UHR collimator control circuit which consists of the following:

- ZCON - Hardware position circuit motor controller
- DMS - UHR collimator assembly
- M3 - DC motor for positioning IN or OUT of the UHR collimator
- Collimator

Actual UHR Collimator Position

The actual UHR collimator position is fed back by optical limit switch IN or OUT.

Nominal UHR Collimator Position

The nominal position is sent to the motor controller by MCB D2. The direction is set if the scan mode is a UHR scan.

UHR Collimator Positioning

To move the UHR collimator IN, set the current to maximum after reaching the optimal limit switch IN position. After the current is held for one second, the current is switched to low with a low current signal from the MCB.

To move the UHR collimator OUT, the current is set to maximum after reaching the optimal limit switch OUT position. The current is switched OFF with disable signals from the MCB.

During the scan, the current is switched to maximum; at the end it is set to low.

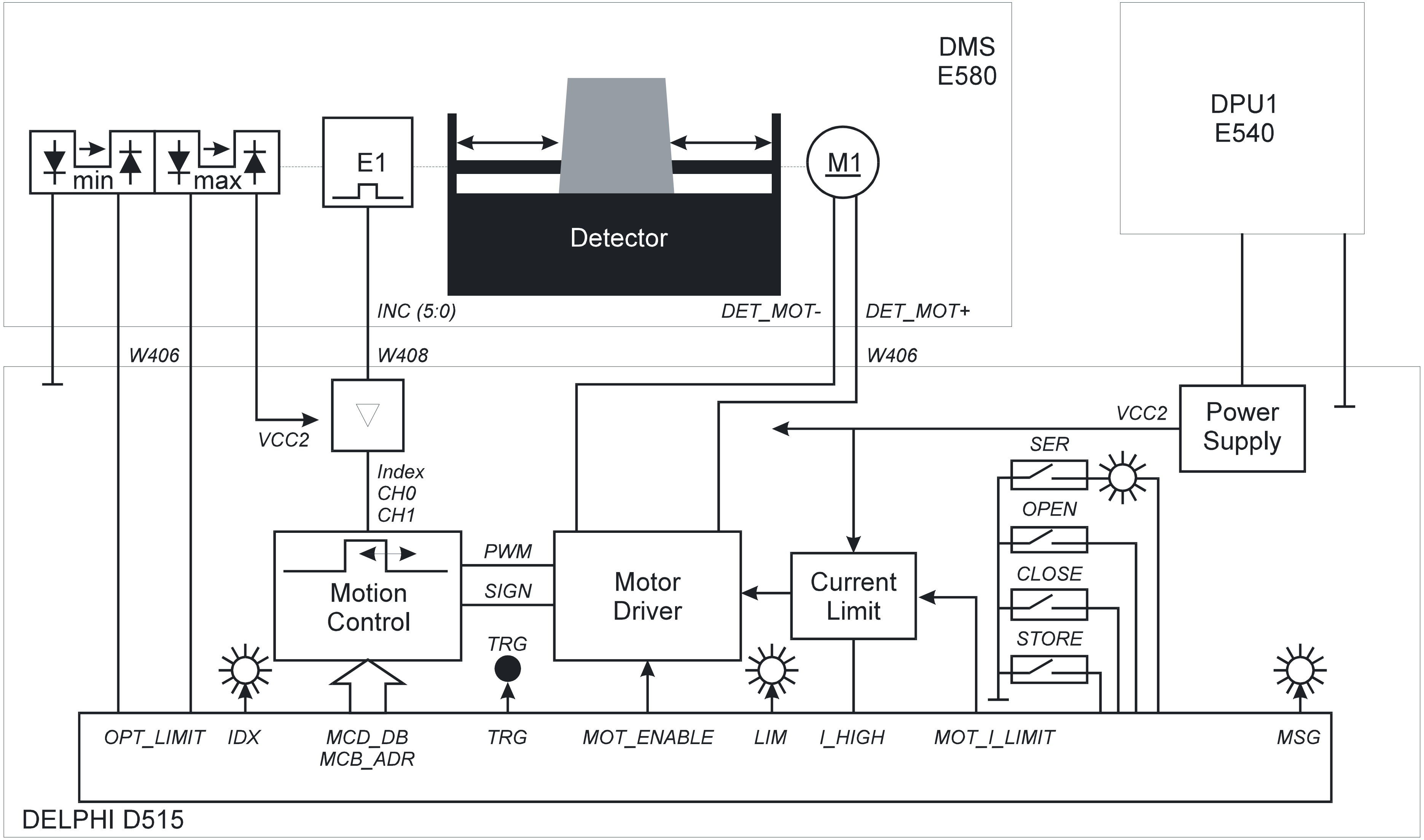

DMS
E580
DPU1
E540
min
max
E1
Detector
M1
INC (5:0)
DET_MOT-
DET_MOT+
W406
W408
W406
VCC2
Index
CH0
CH1
VCC2
Power Supply
SER
OPEN
CLOSE
STORE
PWM
SIGN
TRG
Motion Control
Motor Driver
Current Limit
OPT_LIMIT
IDX
MCD_DB
MCB_ADR
TRG
MOT_ENABLE
LIM
I_HIGH
MOT_I_LIMIT
MSG
DELPHI D515

Figure 3-121: Ultra-High Resolution Collimator Block Diagram

Optical Limit Switches

Define the IN and OUT positions of the UHR collimator when UHR mode is selected.

Service Switches:

- Service - Select service operation
- UHR IN - Moves the UHR collimator IN
- UHR OUT - Moves the UHR collimator OUT

LEDs

- UHR
- HI_CUR - Displays the maximal current
- UHR_LIM - Displays when the UHR is in one of the limit switches.

Power Supply

The 24V of the motor M3 is provided by **PWR24** via **DPU_1** P_24V. The **PWR24** signal is controlled by MPE signals.

DMS Parts Replacement

Precautionary Measures Regarding Electrical Voltage

Before you start the procedure outlined in this manual, make sure that you read and understand the warnings listed below.

WARNING

ELECTRICAL HAZARD! PRIOR TO ANY SERVICE AND MAINTENANCE ACTIVITIES INSIDE COMPONENTS:

- **SWITCH OFF THE SYSTEM AT THE MAIN POWER SUPPLY (USING THE ON-SITE ON-OFF SWITCH) AND THE INTERNAL/EXTERNAL UNINTERRUPTIBLE POWER SUPPLY (UPS)**
- **MAKE SURE THAT NO OTHER PERSON CAN SWITCH ON POWER OR SWITCH OFF THE SECURITY MEASURES, WHEN INSTALLATION, MAINTENANCE OR SERVICE WORK ON THE SYSTEM IS PERFORMED.**

WARNING

ELECTRICAL HAZARD! WHEN PERFORMING ANY PROCEDURE INSIDE THE PDC:

- **SWITCH OFF ALL EXTERNAL POWER, E.G. POWER FOR X-RAY WARNING LAMP.**
- **PRIOR TO ANY INTERVENTION IN THE PDC, ALLOW AT LEAST FIVE MINUTES DISCHARGE TIME AFTER THE LAST SCAN. HAZARDOUS VOLTAGE LEVELS (>500V) MAY BE PRESENT EVEN IF THE SYSTEM IS SWITCHED OFF.**

AFTER FINISHING ANY SERVICE ACTIVITY, ENSURE THAT ALL COVERS OF THE MX8000, INCLUDING THE MYLAR GASKET, ARE CLOSED.

SAFETY:

IN ADDITION TO THE WARNINGS LISTED ABOVE, MAKE SURE TO FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN CHAPTER 1 OF THE MX8000 AND MX8000 DUAL SERVICE MANUAL. FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

CAUTION

FOLLOW THE GUIDELINES IN *“ESD—Anti-Static Field Service Kit”* BEFORE PERFORMING ANY SERVICE PROCEDURE.

ESD—Anti-Static Field Service Kit

This section describes the use of the ESD—Anti-Static Field Service Kit with the Mx8000 systems.

Purpose

This field service kit is designed to connect a field service engineer and the static-dissipative work mat to the same ground point. The wrist strap and the dissipative mat drain any static charges from the body and from any conductive objects placed on the mat, and prevent the generation of any new static charges.

Tools

Standard FSE tool kit

Parts

ESD—Anti-Static Field Service Kit (see *Figure 3-122*) P/N 335077

- Static-dissipative work mat, with pockets for storing kit components
- Ground cord assembly
  - Coiled cord
  - Black cord
  - Black snap
- Banana Plug
- Alligator clip
- Adjustable wrist strap

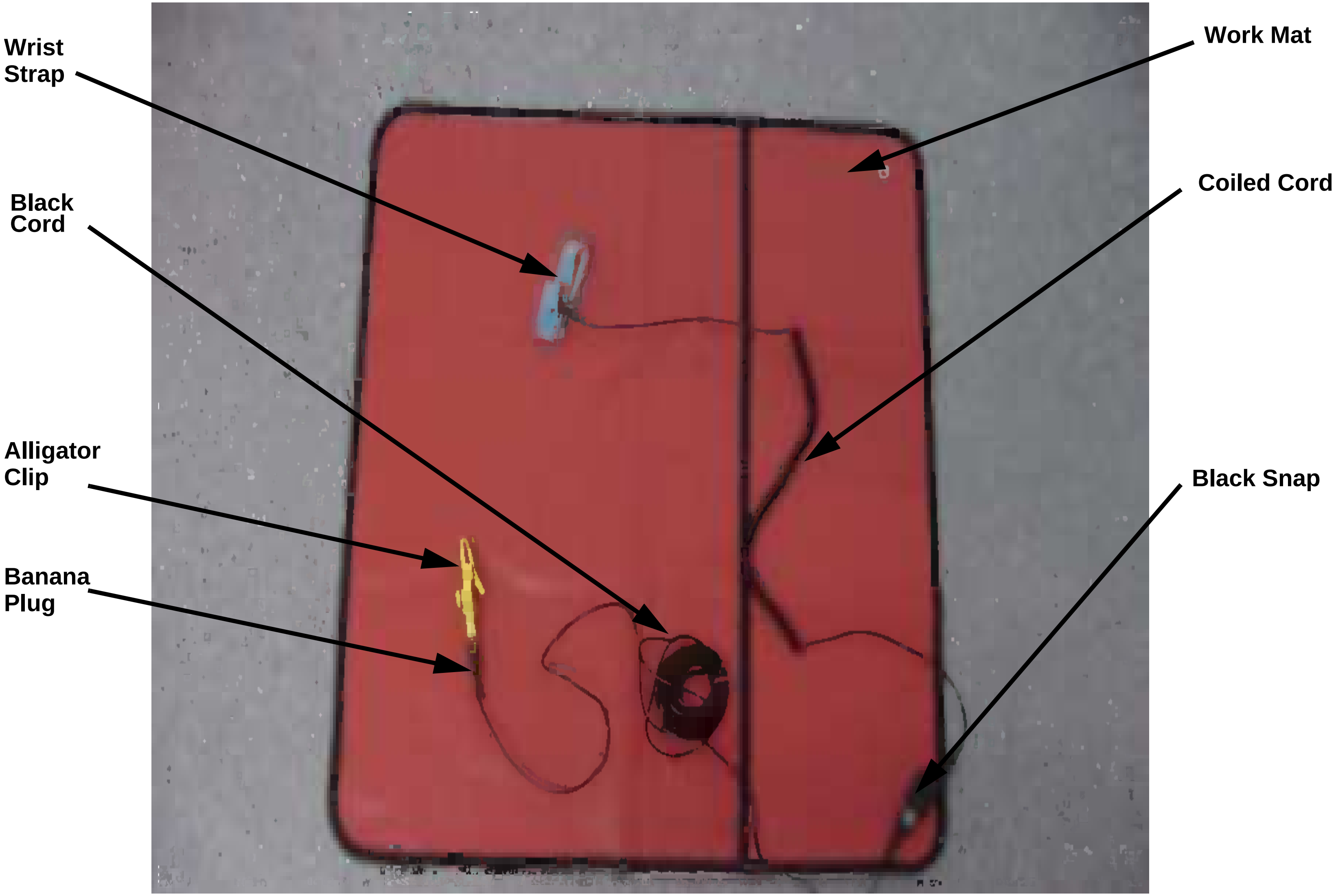

Wrist Strap
Black Cord
Alligator Clip
Banana Plug
Work Mat
Coiled Cord
Black Snap

Figure 3-122: ESD Service Kit Parts

Procedure

⚠ WARNING

ELECTRICAL HAZARD! BEFORE WORKING ON ELECTRICAL PARTS IN THE GANTRY ROTOR, ENSURE THAT THE GROUND CABLE IS CONNECTED TO THE STATOR AND ROTOR. TO PREVENT AN ELECTRIC SHOCK, FOLLOW THE PROCEDURE BELOW.

Connecting the Ground Cable to the Rotor and Stator

The rotor bearing is made from non-conductive material. Therefore, it is required to connect the rotor to a good ground prior to performing any service procedure on the rotor.

1. Move the couch out and down from the gantry panel.
2. Turn the gantry power OFF, and turn the F1 switch in the PDC OFF.
3. Open the front cover, and turn the S301 to the zero position.
4. Rotate the rotor by hand until the DMS is at 12 o’clock, and lock the rotor with the mechanical brake.

5. Connect the ground cable to the rotor ground point and to the stator ground point (see *Figure 3-123*).

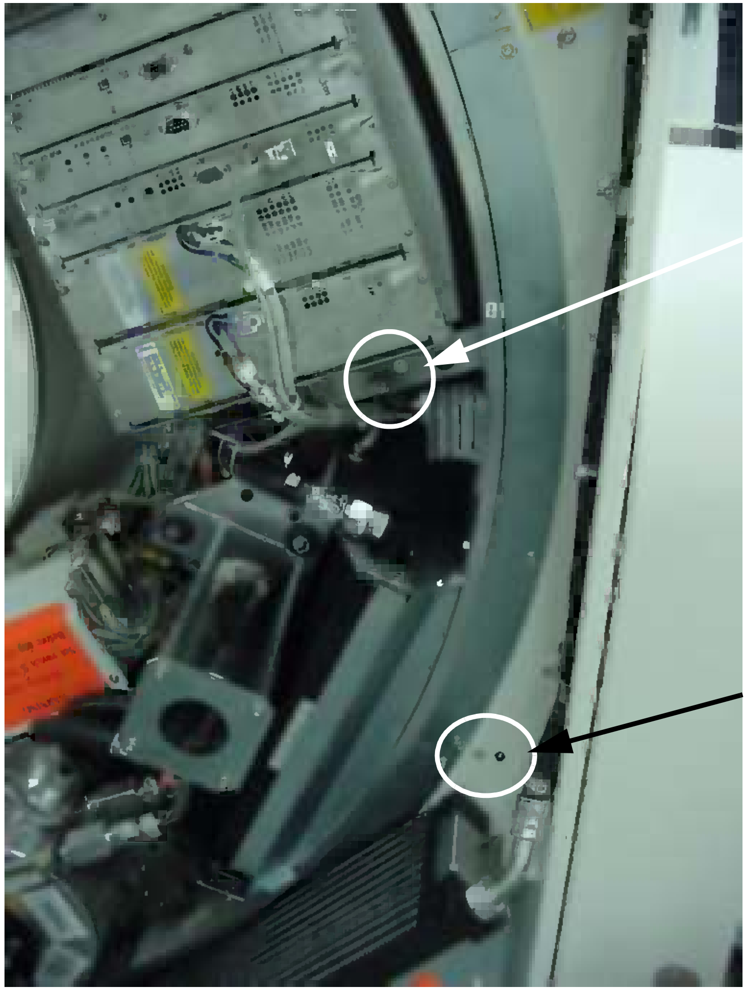

Ground Point
Stator Ground Point

Figure 3-123: Ground Cable Connections

Ground Cable Connection

NOTE:

The stator contains two ground points (see *Figure 3-124*). Use one for the ground cable connection to the rotor, and the other to connect the ESD Field Service Kit.

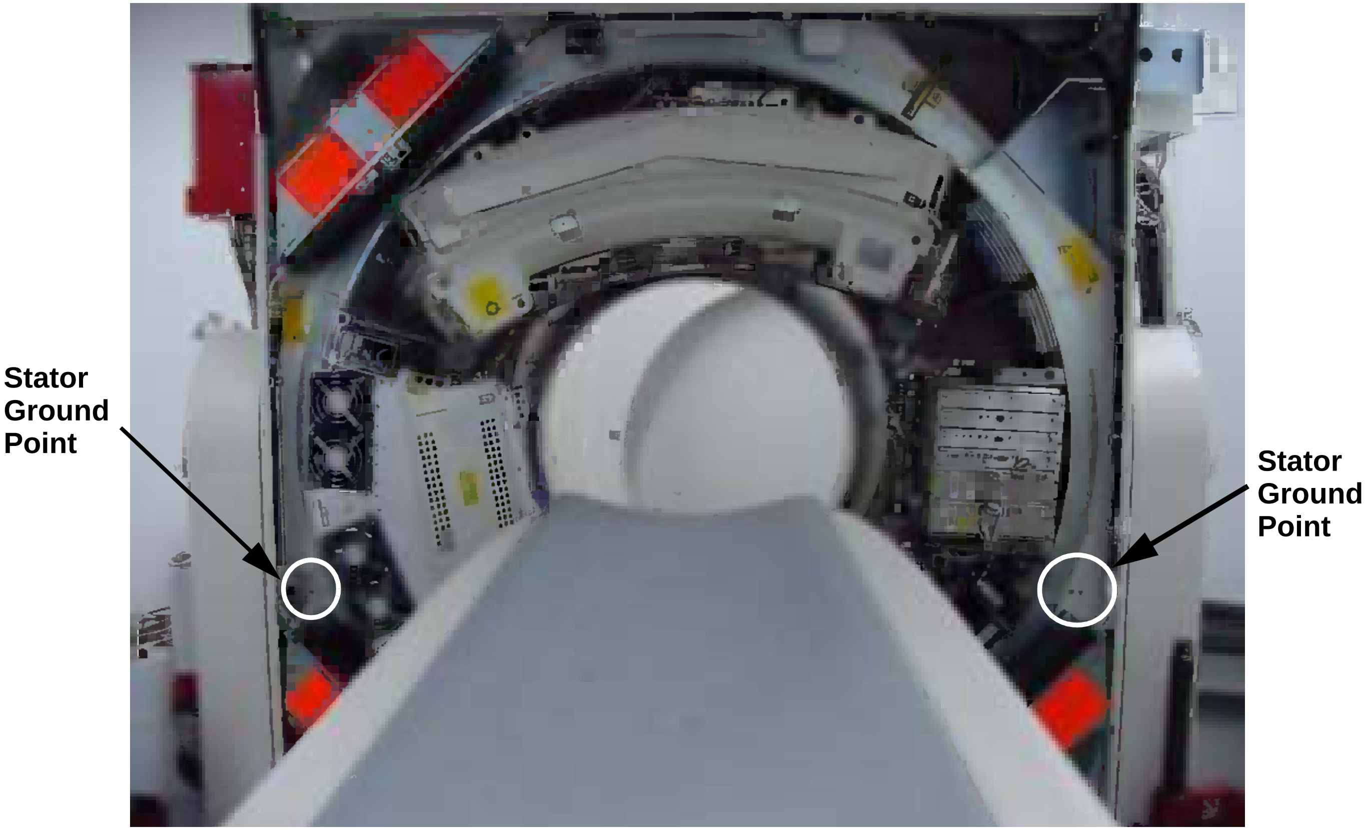


Figure 3-124: Stator Ground Points

Connecting the ESD Field Service Kit

1. Unfold the work mat on the couch and remove the kit contents from the mat pockets.
2. Snap the ground cord assembly to the work mat by means of the large black snap (see *Figure 3-125*).

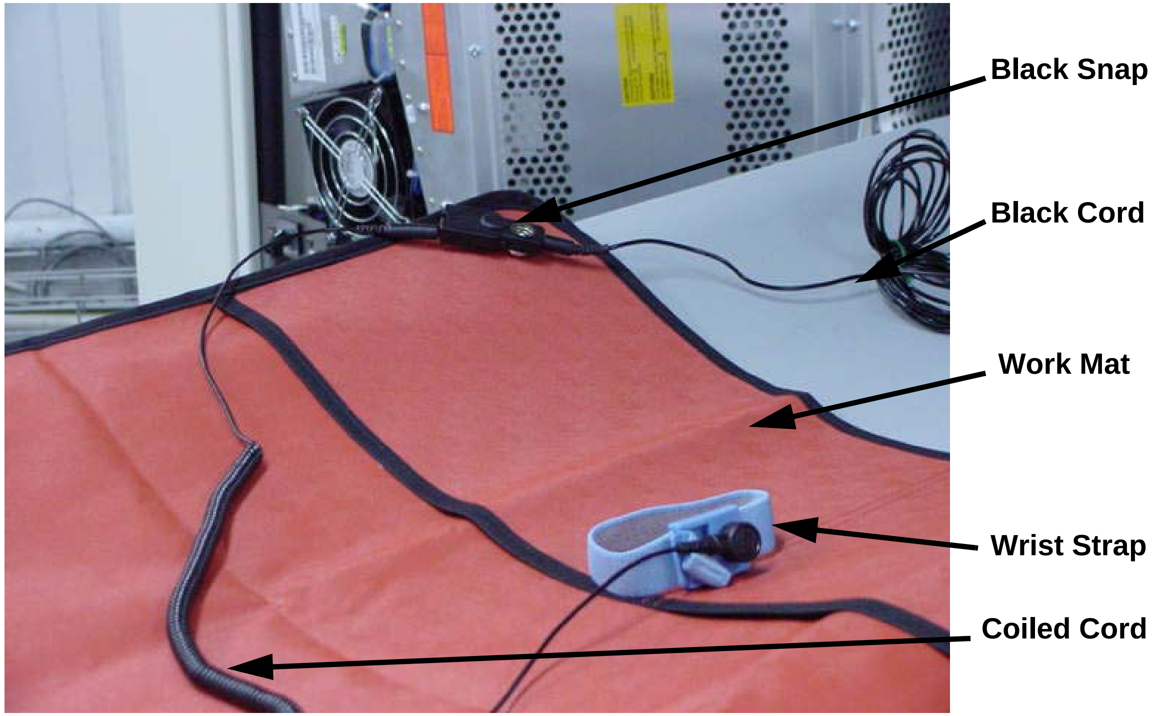


Figure 3-125: ESD Field Service Kit Components

3. Slip on the elastic wrist strap. Adjust so that the wrist strap fits snugly, yet comfortably.
4. Connect the coiled cord of the ground cord assembly to the wrist strap by means of the small plastic snap.

5. Connect the ESD to the Stator as follows:
    a. Connect the black cord of the ground cord assembly to the stator ground point by the banana plug (see *Figure 3-126*).

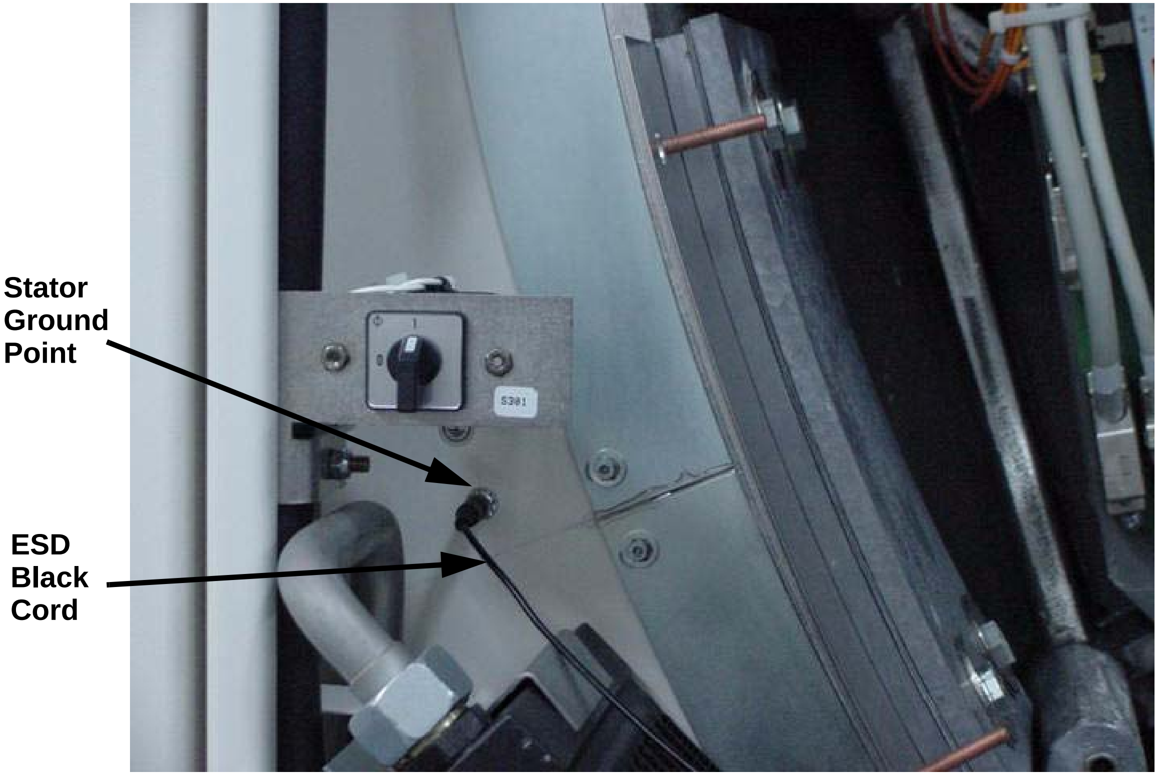


Figure 3-126: ESD Connection to the Stator

The field service engineer is now static-protected, and can safely handle static-sensitive boards and components. Set each part on the grounded mat only.

Transport replacement PC boards in static-shielding bags or containers. Place any faulty boards removed from the equipment in static-shielding packaging so that additional damage is not done during shipment to the repair depot.

⚠ **CAUTION**

THE GROUNDING PROCEDURES DETAILED ABOVE EFFECTIVELY REMOVE STATIC FROM CONDUCTIVE OBJECTS LIKE THE HUMAN BODY OR METAL PARTS. HOWEVER, NONCONDUCTIVE OBJECTS (SUCH AS SYNTHETIC CLOTHING, PLASTIC COFFEE CUPS, CIGARETTE PACKS, VINYL WORK ORDER ENVELOPES, OR COMMON PLASTICS) CAN ALSO CARRY LARGE AMOUNTS OF STATIC CHARGE, AND THE CHARGES ON NONCONDUCTORS SUCH AS THESE CANNOT BE REMOVED BY GROUNDING. THEREFORE, THE ENGINEER MUST TAKE CARE TO KEEP ALL SUCH NONCONDUCTORS AS FAR FROM THE WORK AREA AND THE SENSITIVE EQUIPMENT AS POSSIBLE.

Replacing Data Measurement System Components

This section describes the replacement procedures for the following field replaceable units (FRU) for Data Measurement System (DMS), in the order listed:

- Complete DMS - *“Replacing the Complete DMS”*
- Cradle Assembly - *“Replacing the Cradle Assembly”*
- P-Plane motor - *“The estimated time required to replace the P-Plane motor is 1 hour.”*
- P-Plane encoder - *“Replacing the Encoder of the P-Plane”*
- P-Plane optical switch - *“Use the following procedure to replace the optical switch of the P-Plane:”*
- P-Plane mylar - *“Replacing the P-Plane Mylar”*
- Cradle temperature sensor - *“Replacing the Cradle Temperature Sensor”*
- GI card - *“Replacing GI Cards”*
- Detector module - *“Replacing Detector Modules”*
- Cover temperature sensors - *“Replacing the Cover Temperature Sensors”*
- Cover fans - *“Replacing the DMS Cover Fan”*
- DMS OFF control card - *“Replacing the DMS OFF Control Card”*
- Fan power distributor card - *“Replacing the Fan Power Distribution Board”*

Many of the procedures described tell you to remove the cover of the DMS first. To remove the cover of the DMS, perform the procedure described in *“Removing the Cover of the DMS”*. Then proceed with the appropriate procedure.

Replacing the Complete DMS

⚠ CAUTION

ALL OF THE FOLLOWING PROCEDURES SHOULD BE PERFORMED IN AN ESD-FREE ENVIRONMENT. USE AN ANTI-STATIC WRISTBAND WITH A SOLID GROUND CONNECTION AT ALL TIMES, AND USE AN ANTI-STATIC SHEET TO COVER THE WORK AREA.

Introduction

The purpose of this section is to instruct the FSE in the removal and replacement of the entire DMS unit. The six main sections of the procedure are as follows:

- Unpacking the DMS Field Replacement Unit
- Disconnecting the old DMS
- Removing the old DMS
- Installing the new DMS
- Connecting the new DMS
- Entering New DMS Encoder Settings

In addition, at the end of the procedure you must perform the following:

- Rotor Balancing if necessary (see *“Balancing the Rotor”*)
- Physics and Calibration for:
  - Mx8000 Quad
    or
  - Mx8000 Dual

Parts List

Table 3-35: DMS SERVICE KIT P/N 407-7181-4205

PART NUMBER	DESCRIPTION	QUANTITY	REMARKS
478-7180-1107	DMS TRANSPORT PACK	1	
479-7180-1403	LEFT WHEEL FOOT	2	
479-7180-1304	RIGHT WHEEL FOOT	2	
565-7181-2108	DMS LIFT WELD	1	Lifting bar
564-7180-5616	LEFT ARM MACH	1	DMS lifting bracket, left side
564-7180-5715	RIGHT ARM MACH	1	DMS lifting bracket, right side
567-7181-2809	SLOPES	1	
564-7181-5904	DMS STRETCH LIFT	1	Stretcher pad
560-7180-0405	MODULE BASE TOOL	1	A tool for easy release of a module
479-7181-5205	GI TOOL	1	A tool to pull a GI card
ZT7-1800-330A	GI EXTRACTOR	1	A tool to pull the GI connector
407-7181-0609	MX8000 COLL JIG KIT	1	A set of jigs to calibrate the P-Plane
784-1204-1036	CARTON 40X40X30 cm	1	Accessories box
491-7180-3502	Mx8000/DMS FIELD REPL.MANUAL	1	This manual
TZ01000061A	ANCHOR SHACKLE 5/8"	1	
TZ0-1000-052A	RATCHET STRAP ASSY	1	
HS0-0420-8030	SCRW M8X30 INBUS	8	
ZT8-3201-2101	Jack	1	
565-7181-5606	Lock pin	2	

Tools

- Standard FSE tool-kit
- Standard metric set
- A magnet (to retrieve lost screws)
- Torque meter 0-50 Nm
- Loctite #241

Unpacking the DMS Field Replacement Unit

The DMS Field Replacement Unit comes in two crates. One crate contains the new DMS and the other crate contains tools and accessories required to complete the task.

1. Open the accessories crate and remove the scissors jack and the four wheels (see *Figure 3-127*).

> **NOTE:**
>
> If the rubber pad is present, it must be unscrewed and removed from the top of the scissors jack for the jack to fit under the DMS Crate.

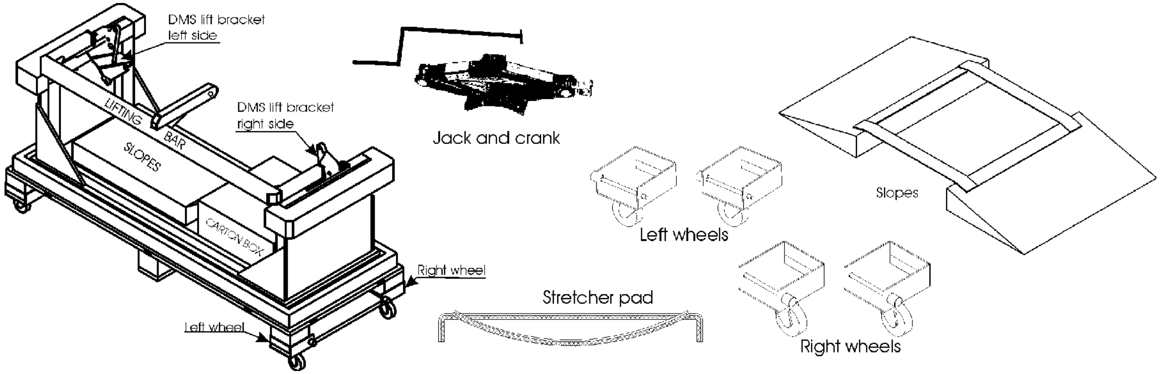

DMS lift bracket left side
DMS lift bracket right side
LIFTING BAR
SLOPES
CARTON BOX
Left wheel
Right wheel
Jack and crank
Left wheels
Slopes
Stretcher pad
Right wheels

Figure 3-127: Accessories Crate and Contents

2. Remove the Lifting Bar, the Lifting Brackets and any remaining accessories from the Accessories Crate.
3. Position the four wheels under the empty DMS crate and secure each wheel with a Wheel Pin (see *Figure 3-128*).

NOTE:

There are two left-handed wheels and two right-handed wheels.

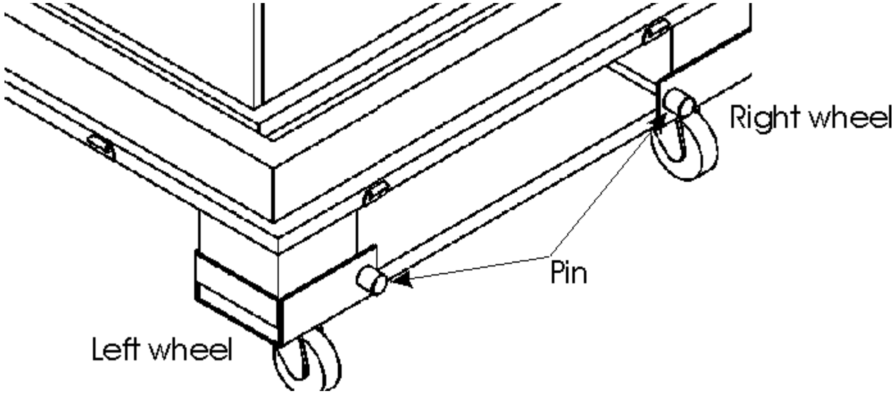


Figure 3-128: Wheel and Pins

Disconnecting the Old DMS

WARNING

THE FOLLOWING ADJUSTMENT PROCEDURE IS DONE WHILE THE GANTRY FRONT COVER IS OPEN. FOLLOW THE INSTRUCTIONS EXACTLY STEP BY STEP AND COMPLY WITH ALL SAFETY PRECAUTIONS FOR YOUR OWN SAFETY.

1. Move the couch Max out and Max down.
2. Press the STOP button on the Gantry.
3. Open the gantry front cover carefully while observing the mylar gasket. Remove it and place it aside.
4. Turn the Service Switch S301 to ZERO position.
5. Position the DMS at the 12 o'clock position and lock the rotor in place with the locking device (see *Figure 3-130*).

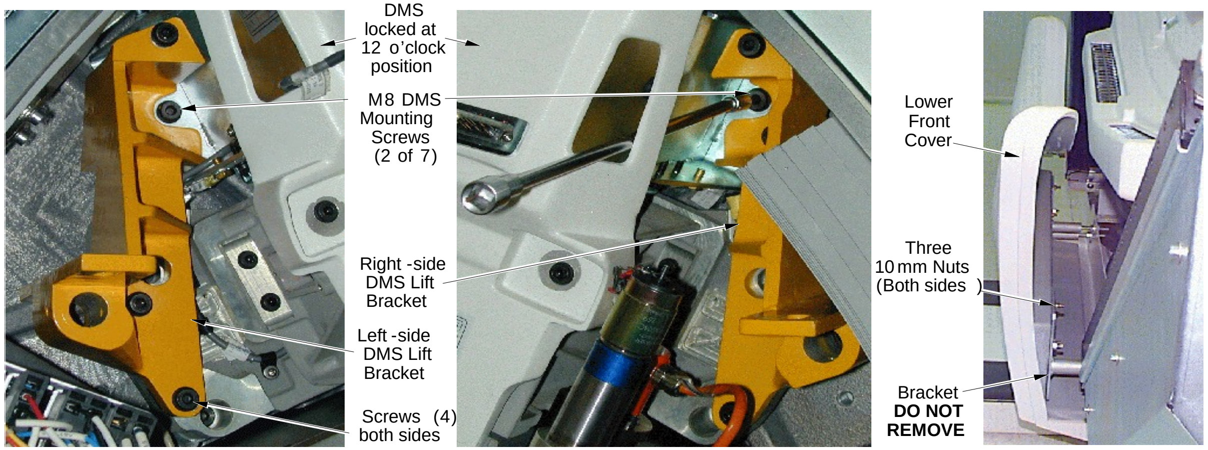
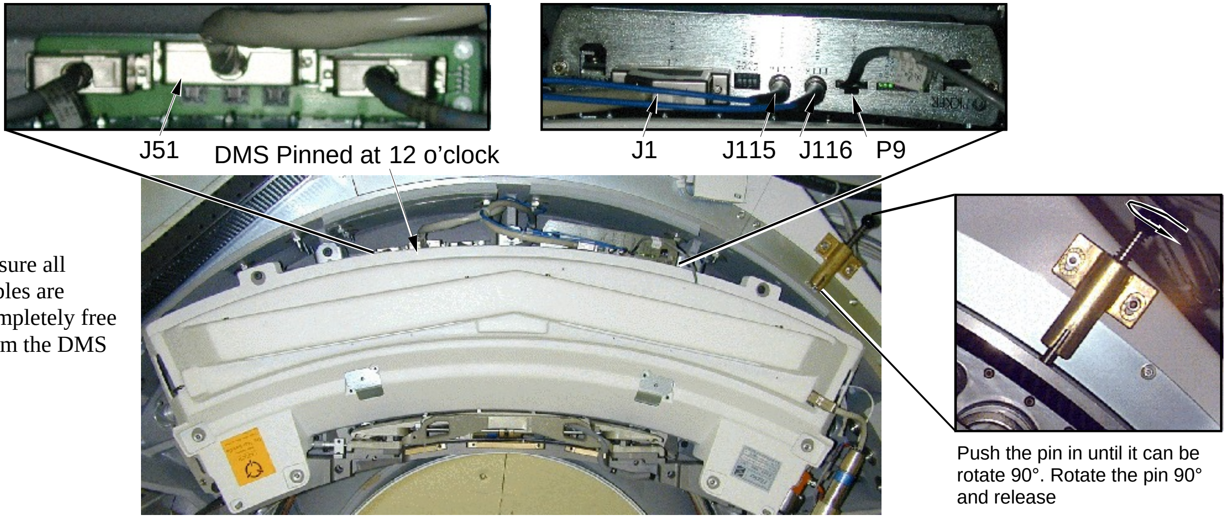

DMS locked at 12 o'clock position
M8 DMS Mounting Screws (2 of 7)
Right-side DMS Lift Bracket
Left-side DMS Lift Bracket
Screws (4) both sides
Lower Front Cover
Three 10 mm Nuts (Both sides)
Bracket **DO NOT REMOVE**

Figure 3-129: Lifting Brackets and Lower Front Cover Nuts

6. In the PDC, switch S1 to the ON position and F9 to the OFF position.
7. Connect one lifting bracket to each side of the DMS (see *Figure 3-129*), with four M8 screws for each bracket. Tighten with torque to 20 Nm.
8. Unscrew and remove the six nuts that secure the middle lower part of the front Gantry cover to the Gantry and remove the cover (see *Figure 3-129*). Do not remove the brackets.
9. Disconnect the following cables from the DMS cover and disconnect the cables ties that connect it to the DMS:
   - — P10 Fan Power Cable
   - — GI #1 Reference Detector Cable. Pull the reference detector cable from the connector and not from the cable!

10. Disconnect the following cables from the RCOM Card (see *Figure 3-130*):

— J1	ACU I/F
— J115	Optic Cable
— J116	Optic Cable
— P9	Temperature sensor
— J51	DMS power



Ensure all cables are completely free from the DMS

Push the pin in until it can be rotate 90°. Rotate the pin 90° and release

Figure 3-130: DMS Connections

11. Release the following cables from the C-Box Motherboard (see *Figure 3-131*). Cut all cable ties that do not secure the cables to the DMS and secure them to the DMS.
    - X3
    - X5
    - X9

    Cut all cable ties that do not secure the cables to the DMS and secure them to the DMS.

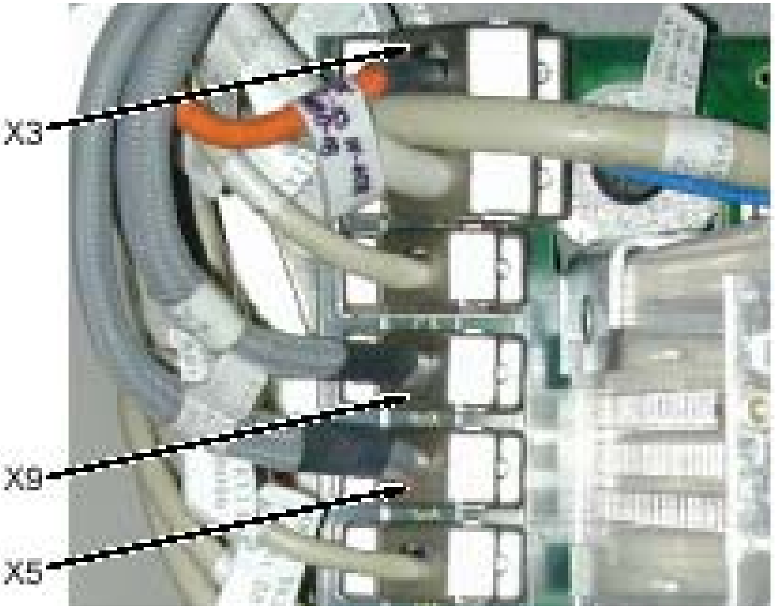


Figure 3-131: C-Box Motherboard Connections

Removing the Old DMS

CAUTION

YOU MUST WEAR ANTI STATIC GLOVES WHEN PERFORMING THE NEXT FOUR STEPS.

1. Remove the two service opening covers on the front of the DMS cover by unscrewing and removing the service opening cover screws with a 2.5 mm hex key (see *Figure 3-132*).
2. Unscrew the two flex-rigid cables from the detector module in each opening. **Use antistatic gloves when touching the flex-rigid cables.**
3. Move the flex-rigid cables out of the way and unscrew the M8 DMS Mounting screw behind the cables in each opening.

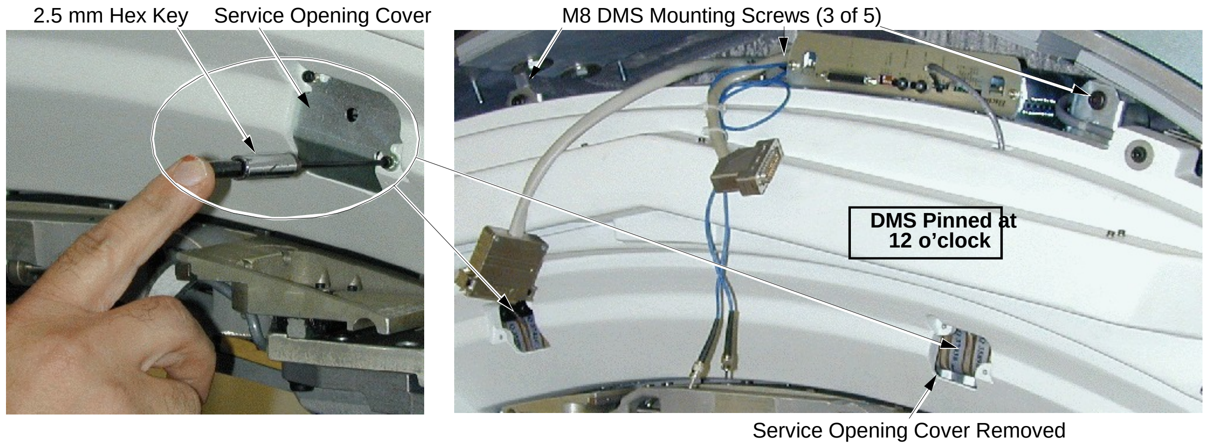

2.5 mm Hex Key
Service Opening Cover
M8 DMS Mounting Screws (3 of 5)
DMS Pinned at 12 o'clock
Service Opening Cover Removed

Figure 3-132: Service Openings and M8 DMS Mounting Screws

NOTE:

Use a 6 mm drive, 6 mm hex bit with a 300 mm extension to remove the M8 DMS Mounting Screw behind the flex-rigid cables. When loose, retrieve the screw with an extension magnet.

4. Reconnect the flex-rigid cables to the modules behind each opening and replace the service opening covers. Tighten the flex-rigid cables with a torque of 40
   Ncm and the service opening cover screws to 80 Ncm.
5. Remove the two M8 DMS mounting screw next to the lifting bracket on each side of the DMS (see *Figure 3-133*).
6. Remove the three M8 DMS mounting screws that connect the DMS Card Cage to the rotating frame (see *Figure 3-132*).
7. Position the ramps from both sides of the connection piece between Gantry and bed. Use the Velcro strips to hold them together.
8. Position the DMS at the 6 o'clock position and lock the rotating frame with the locking device.

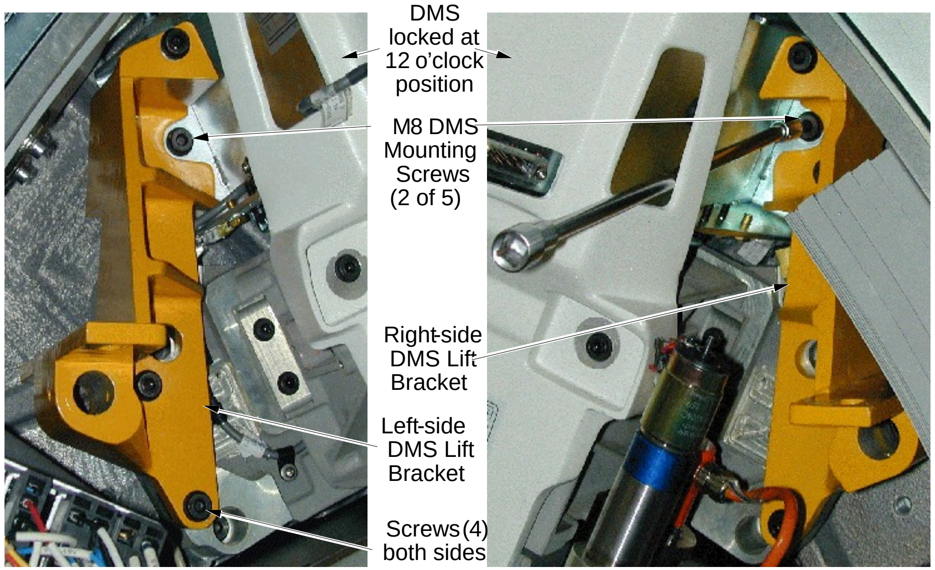

DMS locked at 12 o'clock position
M8 DMS Mounting Screws (2 of 5)
Right-side DMS Lift Bracket
Left-side DMS Lift Bracket
Screws (4) both sides

Figure 3-133: Removing the M8 DMS mounting screws

⚠ **CAUTION**

USE EXTREME CAUTION WHILE REPOSITIONING THE DMS TO THE 6 O'CLOCK POSITION. ENSURE ALL LOOSE CABLES ARE SECURED AND DO NOT GET CAUGHT ON ANY STATIONARY COMPONENT.

9. Insert the lifting bar into the lifting brackets and secure it with the pins.
10. Insert the pins on the DMS Lifting Bar into the holes in the DMS Lifting Brackets (see *Figure 3-134*).
11. Place the empty DMS crate between the Patient Support and the Gantry (see *Figure 3-135*).

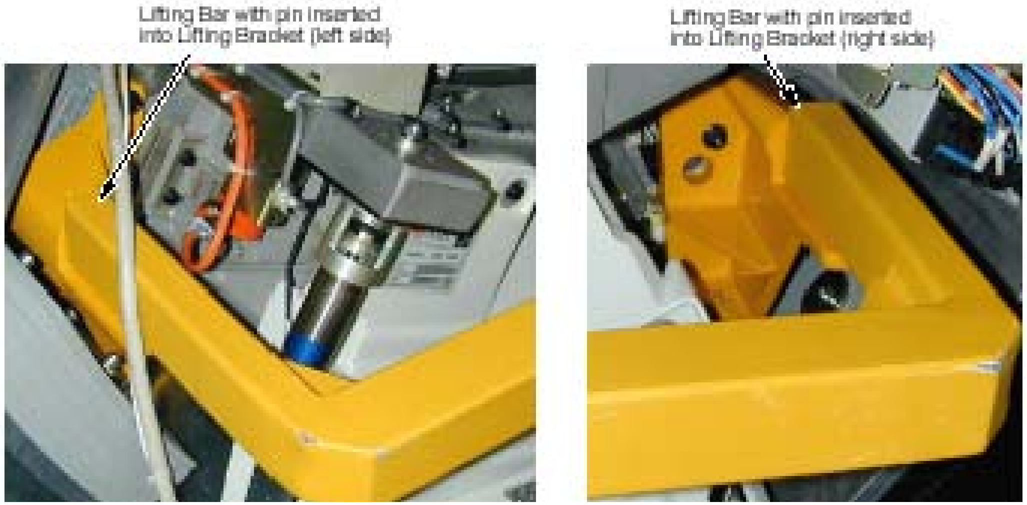

Lifting Bar with pin inserted into Lifting Bracket (left side)
Lifting Bar with pin inserted into Lifting Bracket (right side)

Figure 3-134: Lifting Bar Installed

> **NOTE:**
>
> Position the empty DMS crate so that the holes closest to its edge are adjacent to the Gantry.

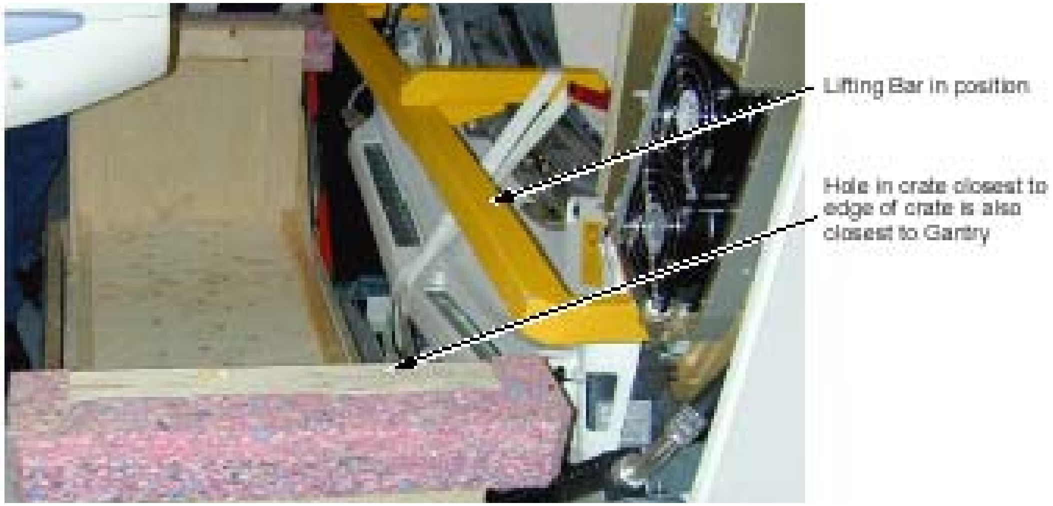
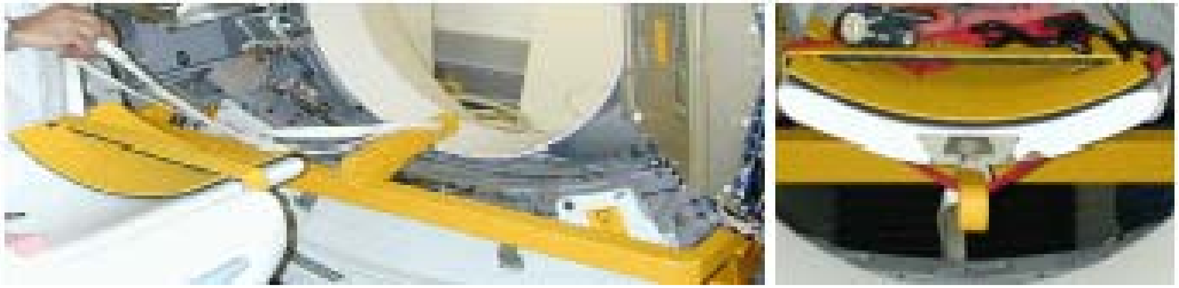

Lifting Bar in position
Hole in crate closest to edge of crate is also closest to Gantry

Figure 3-135: Empty DMS Crate in Position

12. Position the Stretcher Pad over the Gantry end of the Table Top. Move the table support maximum in and then move the Table Top by hand until the Stretcher Pad is directly above the DMS Lifting Bar (see *Figure 3-136*).
13. Secure the DMS Lifting Bar to the Table Top with a lifting strap equipped with a ratchet (see *Figure 3-136*). Insert the strap into the slit in the ratchet, connect the parts of the strap and pull the extra length of the strap until it becomes taut.



Positioning the Stretcher Pad. If the pad is new, some difficulty may be encountered while installing the pad onto the end of the Table Top due to a tight fit.

Table Top extended into the Gantry aperture with the lifting strap attached to the Lifting Bar.

Figure 3-136: Installing the Stretcher Pad

14. Remove the Patient Table sub-frame cover to expose the Patient Table Service Panel (see *Figure 3-137*). Set Service Switch S703 to the Service Mode. Position **1** enables Service mode; position **0** disables Service mode.
15. Carefully raise the Patient Table until the Lifting bar is shifted up slightly.

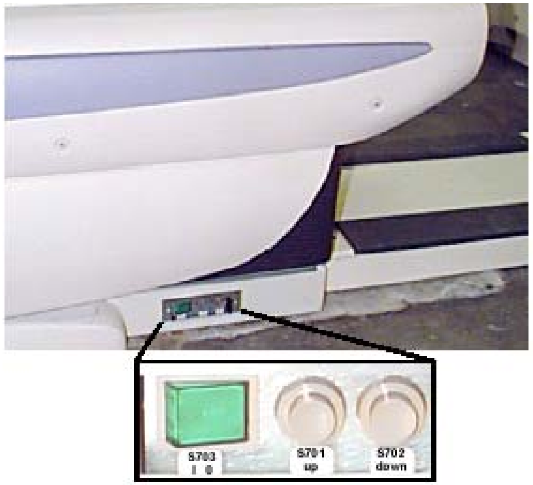


Figure 3-137: Patient Table Service Panel

WARNING

MECHANICAL HAZARD! WITH SERVICE SWITCH S703 SET TO THE SERVICE POSITION, THERE IS NO UPPER AND LOWER SOFTWARE HEIGHT LIMIT. THE SCISSORS CARRIAGE CAN BE DRIVEN UNDER POWER INTO THE SUBFRAME. EXERCISE EXTREME CAUTION WHEN RAISING OR LOWERING THE PATIENT TABLE WITH SERVICE SWITCH S703 IN THE SERVICE POSITION. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL OR SERIOUS DAMAGE TO THE EQUIPMENT.

WARNING

PERFORM THE NEXT STEP WITH TWO PEOPLE. THE NEXT STEP MAY REQUIRE RAISING OR LOWERING THE PATIENT TABLE WITH THE SERVICE SWITCH.
DO NOT PULL THE DMS FROM THE LIFTING BAR!

16. Remove the two M8 screws, one from each side of the DMS next to the lifting brackets (see *Figure 3-138*).

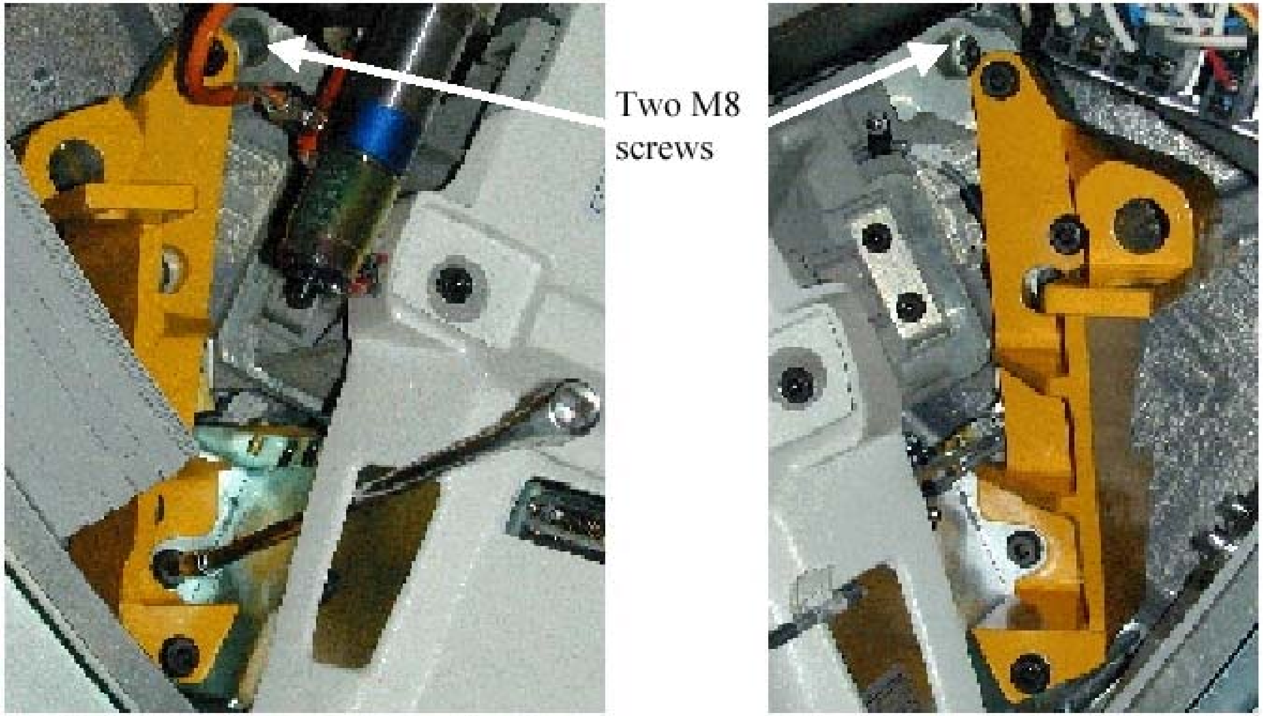


Figure 3-138:

17. While holding the DMS on both sides, gently pull the DMS away from the rotating frame, left side first and then the right side. Observe the P-Plane motor and the markers assembly while performing this step.
18. When the DMS is completely free of the rotating frame, carefully raise the Patient Table several centimeters and pull the DMS away from the Gantry. Observe the marker on the right side.
19. Position the DMS above the empty DMS crate. Lower the DMS into the crate. Make sure that the holes in the Lifting Brackets line up with the holes in the crate.
20. Secure the DMS to the crate with the Lifting Brackets. Open the new DMS crate and remove the two long screws to secure the old DMS. Tighten with a torque of 25 Nm.

21. Release the tension on the lifting strap and remove the DMS Lifting Bar.
22. Raise the Patient Table to its maximum height.

NOTE:

Make sure the Patient Table is at its maximum height to provide clearance for the DMS Unit in its crate with the wheels attached. Use two people to lift the crate over the footswitch.

23. Move the old DMS and crate out of the way and use the jack to remove the four wheels from the crate.

Removing Extra Weights From the Rotor

The new DMS is equipped with several weights to bring it to a certain weight. If the DMS that you just removed is an old type of DMS it is required to remove extra weights from the rotor.

How to Identify an Old Type of DMS

Inspect the back of the DMS. If there are weights present, it is a new type of DMS (see *Figure 3-139*).

DO NOT REMOVE ANY WEIGHTS FROM THE ROTOR. Continue to *“Installing the New DMS”*.

If there are no weights present, remove extra weights from the rotor. The weights are marked with the letter W (see *Figure 3-139*).

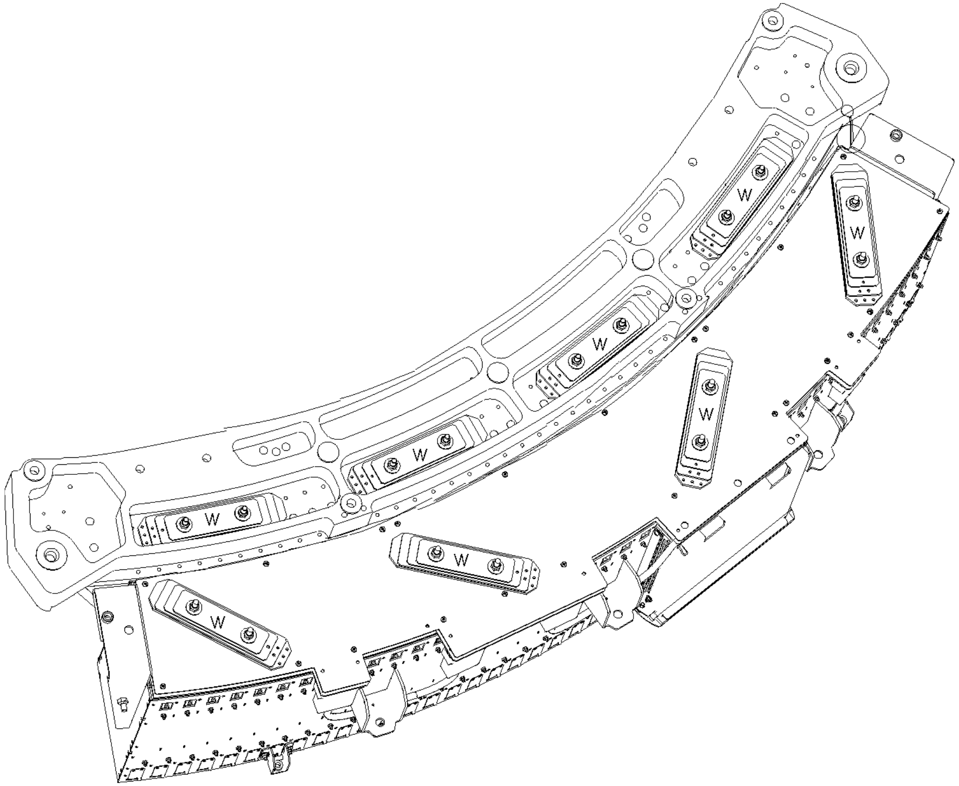


Figure 3-139:

Procedure for Removing Extra Weights From the Rotor

1. Remove 6 thin lead plates from the rotor, three from each group. The groups are marked with the letter **W** and weights nuts are marked with a black circle (see *Figure 3-140*). The over all weight to be removed is approximately 3.5 kg.
2. Apply a few drops of Loctite #241 on the eight thread studs and close the weight nuts in a torque of 10.2 Nm.

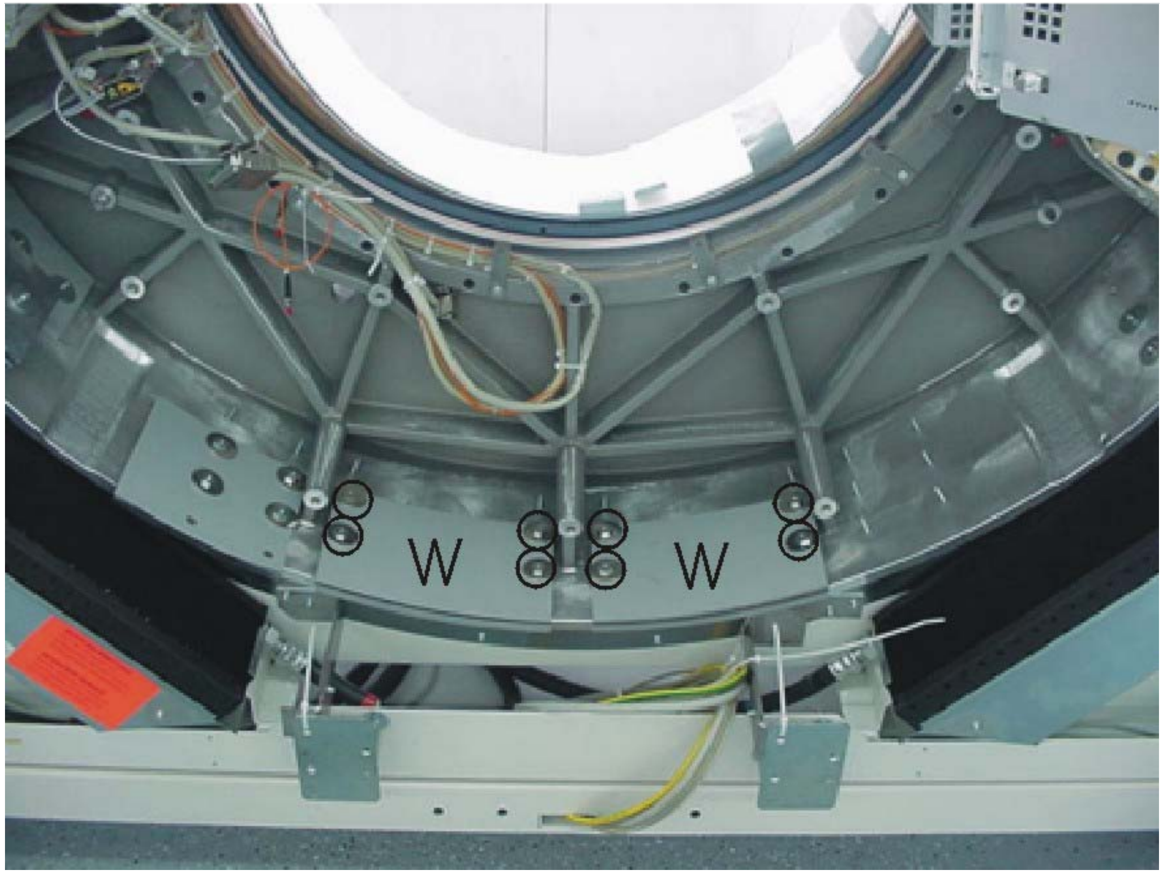


Figure 3-140:

Installing the New DMS

1. Open the new DMS crate and set the crate cover aside.
2. Attach the four wheels to the new DMS Unit crate with the jack (see *Figure 3-128*).

NOTE:

There are left-handed and right-handed wheels.

NOTE:

If the rubber pad is present, it must be unscrewed and removed from the top of the scissors jack for the jack to fit under the DMS Crate.

3. Position the new DMS Unit in the crate between the Patient Table and the Gantry.

NOTE:

Make sure the Patient Table is at its maximum height to provide clearance for the new DMS Unit in its crate with the wheels attached.

4. Remove the screws that attach the Lifting Brackets to the crate and insert the pins on the Lifting Bar into the holes in the Lifting Brackets.
5. Move the Patient Table by hand until the Stretcher Pad is directly above the DMS.
6. Secure the DMS Lifting Bar to the Table Top using a lifting Strap equipped with a ratchet (see *Figure 3-136*).

7. Raise the Patient Table with the Service Switch (SW 703) until the lifting strap is taut (if necessary), and then carefully lift the DMS until it is hanging free.

WARNING

MECHANICAL HAZARD! WITH SERVICE SWITCH S703 IN THE SERVICE POSITION, THERE IS NO UPPER/LOWER SOFTWARE HEIGHT LIMIT. THE SCISSORS CARRIAGE CAN BE DRIVEN UNDER POWER INTO THE SUBFRAME. EXERCISE EXTREME CAUTION WHEN RAISING/LOWERING THE PATIENT TABLE WITH SERVICE SWITCH S703 IN THE SERVICE POSITION. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL OR SERIOUS DAMAGE TO THE EQUIPMENT.

8. With two people, guide the DMS into position as the Table support is moved carefully by hand toward the Gantry. Make sure that the guide holes in the back of the DMS Unit line up with the Guide Pins on the rotating frame (see *Figure 3-141*).
9. Carefully move the Table Top in and out by hand and/or up and down with the Service Panel until the DMS is positioned correctly. Then push it firmly into the pins, the left side first and then the right side.

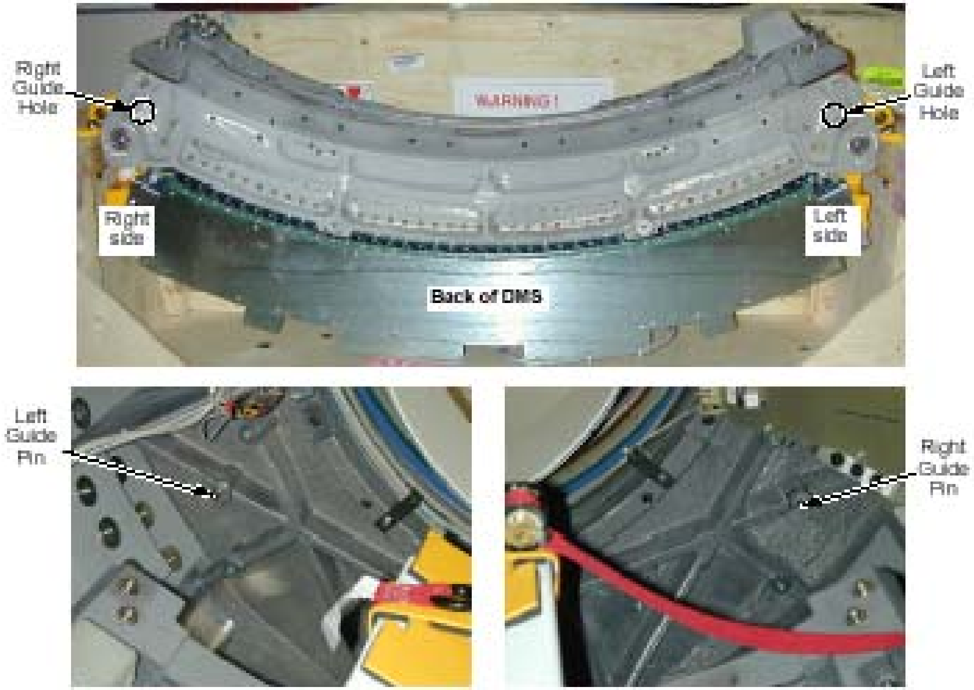


Figure 3-141: DMS Alignment

⚠ WARNING

ROTATING MACHINERY HAZARD. USE THE NEW M8 DMS MOUNTING SCREWS PROVIDED WITH THE REPLACEMENT DMS UNIT TO MOUNT THE REPLACEMENT DMS UNIT.
FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY AND/OR DEATH TO PERSONNEL.

10. Using the new M8 DMS Mounting Screws provided with the replacement DMS Unit, insert and snugly tighten three M8 DMS Mounting Screws in the holes that attach the DMS Card Cage to the rotating frame. Do not torque the screws at this time.
11. Lower the Patient Table, remove the lifting strap and remove the DMS Lifting Bar.
12. Move the Patient Table away from the Gantry and move the empty DMS crate out of the way.
13. Release the rotating frame-locking device, position the DMS at the 12 o’clock position and re-engage the locking device.

NOTE:

Use extreme caution while repositioning the DMS to the 12 o’clock position. Ensure all loose cables are secured and do not get caught on any stationary component.

14. Remove the two service opening covers on the front of the DMS cover by unscrewing and removing the service opening cover screws with a 2.5 mm hex key (see *Figure 3-132*).
15. Unscrew the two flex-rigid cables from the detector module in each opening.
16. Move the flex-rigid cables out of the way and insert a new M10 DMS Mounting screw behind the cables in each opening. Tighten the new screw in each service opening with a torque of 39 Nm.

NOTE:

Use a ¼” drive, 6 mm hex bit with a 300 mm extension to insert the new M10 DMS Mounting Screw behind the flexi-rigid cables.

17. Reconnect the flex-rigid cables to the modules behind each opening and replace the service opening covers. Tighten the flex-rigid cables with a torque of 40 Ncm and the service opening cover screws with a torque of 80 Ncm.
18. Insert a new M8 DMS mounting screw next to the lifting bracket on each side of the DMS (see *Figure 3-129*). Tighten each screw with a torque of 39 Nm.
19. Tighten the three DMS Card Cage Mounting Screws (previously tightened snugly) with a torque of 39 Nm.
20. Remove the Lifting Brackets from the new DMS Unit and attach them to the empty DMS crate. Use only one screw per bracket.
21. Place all accessories into the empty DMS crate including the DMS Lifting Bar. Make sure all parts are included according to *Table 3-35*. Secure the Lifting Bar in place.

Connecting the New DMS Unit

1. Reconnect and route all cables disconnected in the *“Disconnecting the Old DMS”*. Replace any tie-wraps removed earlier.
2. Replace the lower middle front Gantry cover and secure it in place by tightening the nuts. Refer to Figure 3.
3. Release the rotating frame locking device.
4. Rotate the rotor manually and verify that nothing is touching the stator.
5. Return Patient Table Service Switch S703 to the normal operation mode (position zero) and replace the sub-frame cover.
6. Return switch S1 to **OFF** and switch F9 to **ON** in the PDC.
7. Return all the DMS service kit components to the box.

Balancing the Rotor

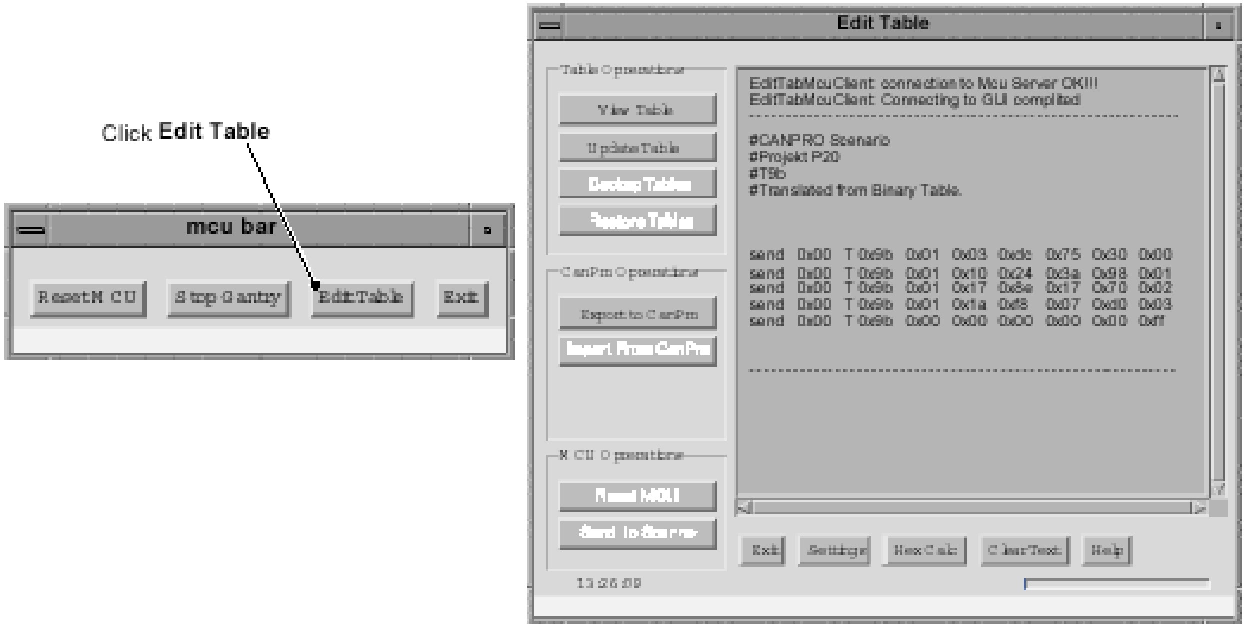
If the old DMS was without any weights you must perform the rotor balancing procedure according to Appendix A and then return to the next section.

If the old rotor had weights there is no need to perform the rotor balancing procedure. Proceed to the following section.

Entering New DMS Encoder Settings

The P-Plane collimator encoder settings for each system cradle are specified in the P-Plane Collimator document shipped with the system (D/N 451-7180-0506 in the envelope with the DMS, Data Measuring System). This procedure describes how to enter the new encoder settings on the host computer.

1. With the application software running on the host computer, click on **Service | MCU Utilities** to display the MCU bar window.
2. Click **Edit Table** to display the Edit Table window (see *Figure 3-142*).

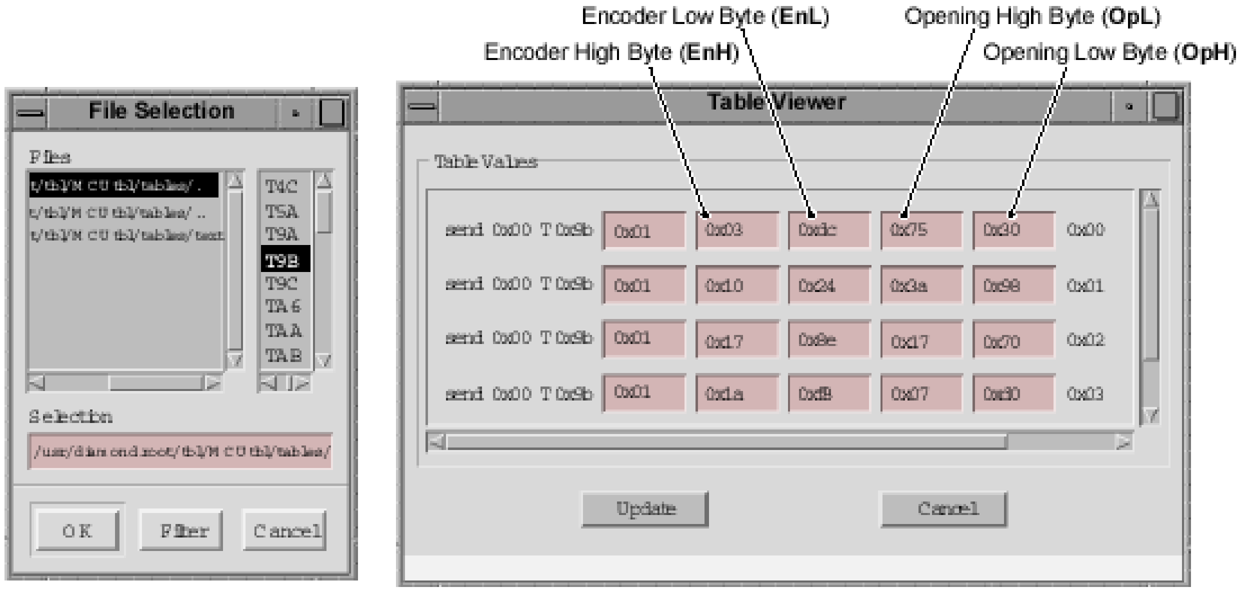

Click Edit Table
mcu bar
Reset MCU
Stop Gantry
Edit Table
Exit
Edit Table
Table Operations
View Table
Update Table
Backup Tables
Restore Tables
CanPro Operations
Export to CanPro
Import From CanPro
MCU Operations
Reset MCU
Send to Server
13:26:09
Exit
Settings
HexCalc
ClearText
Help

```
EditTabMcuClient: connection to Mcu Server OK!!!
EditTabMcuClient: Connecting to GUI complited
-----------------------------------------------------------------

#CANPRO Scenario
#Projekt P20
#T9b
#Translated from Binary Table.



send  0x00  T 0x9b  0x01  0x03  0xdc  0x75  0x30  0x00
send  0x00  T 0x9b  0x01  0x10  0x24  0x3a  0x98  0x01
send  0x00  T 0x9b  0x01  0x17  0x8e  0x17  0x70  0x02
send  0x00  T 0x9b  0x01  0x1a  0xf8  0x07  0xd0  0x03
send  0x00  T 0x9b  0x00  0x00  0x00  0x00  0x00  0xff


-----------------------------------------------------------------
```

Figure 3-142: MCU bar and Edit Table Windows

> **NOTE:**
>
> Only the first two lines in the Edit Table window are displayed when the Edit Table window is first displayed. Table values are shown only after viewing a selected table.

3. Click **Update Table** to display the File Selection window (see *Figure 3-143*).
4. Scroll down to find and select table T9B. Click **OK** (see *Figure 3-143*).


Encoder Low Byte (EnL)
Opening High Byte (OpL)
Encoder High Byte (EnH)
Opening Low Byte (OpH)
File Selection
Files
T4C
T5A
T9A
T9B
T9C
TA6
TAA
TAB
Selection
OK
Filter
Cancel
Table Viewer
Table Vales
Update
Cancel

```
send 0x00 T 0x9b  0x01  0x03  0xdc  0x75  0x30  0x00
send 0x00 T 0x9b  0x01  0x10  0x24  0x3a  0x98  0x01
send 0x00 T 0x9b  0x01  0x17  0x8e  0x17  0x70  0x02
send 0x00 T 0x9b  0x01  0x1a  0xf8  0x07  0xd0  0x03
```

Figure 3-143: File Selection Window and Table Viewer

5. Modify the values in the Table Viewer window. Replace the **EnH**, **EnL**, **OpH** and **OpL** values in each line with the appropriate values from the P-Plane Collimator document.
6. Click **Update** after entering the data for the system to accept the data.

7. On the **Edit Table** window, click **View Table**, select **T9B** and click **OK** to check that the host is updated.
8. Switch off the Gantry.
9. Select **Logout** from the **File** menu on the **Patient Data Screen**. Switch ON the Gantry and log in.

Mx8000 Physics Calibration

Use the latest version Physics file to perform the calibrations listed below before running acceptance tests and before permitting any clinical operation of the equipment. Make sure that all results fall within the permitted tolerances.

Perform the calibrations in the following order:

- Dynamic Focal Spot (DFS) and axis calibration (XRT alignment in the X-direction)
- Full air calibration
- Phantom calibration

Mx8000 Acceptance Test

This section contains the acceptance tests for the system, which includes an impulse response (IR) check and a slice width (SW) check.

Image Noise Standard Deviation Checks

For each combination of scan parameters (each row) in Table 4, scan twice using Multipoint calibration, Image Balance and the protocols in Table 3. Use the water layer of the system phantom for the head scans and the aculon layer of the system phantom for the body scans.

On the result images, place a region of interest (ROI) at the center with an area of 7,000±500 mm^2 for the head phantom and an area of 14,000±500 mm^2 for the body phantom. Average the values from the two scans and enter the result into the appropriate cells of Table 4. Take these measurements using a single image on a full screen.

Mx8000 Dual Physics Calibration

Perform the calibration described in this section before running acceptance tests and before permitting any clinical operation of the equipment. Make sure that all results fall within the permitted tolerances.

This chapter describes the following, in the order listed:

- Dynamic Focal Spot (DFS) and axis calibration (XRT alignment in the X-direction)
- Full air calibration
- Phantom calibration

Mx8000 Dual Acceptance Test

This section contains the acceptance tests for the system, which includes an impulse response (IR) check and a slice width (SW) check.

Image Noise Standard Deviation Checks

See the Mx8000 Physics file and the Mx8000 Dual Physics file..

Removing the Cover of the DMS

Many of the procedures described tell you to remove the cover of the DMS first. To remove the cover of the DMS, do the following:

1. Position the DMS at the 12 o'clock position.
2. Lock the rotor in place using the locking device.
3. Remove the cover of the DMS as follows (see also *Figure 3-144*):
4. Disconnect the temperature sensor connector (P6 on the RCOM card).
5. Disconnect the temperature sensor connector on the left side of the cover.
6. Disconnect the power connector for the fans (P10 on the right side of the cover).
7. Open the six screws that hold the cover in place, using a 5 mm Allen key.
8. Pull the cover toward you, and place it in a safe place.

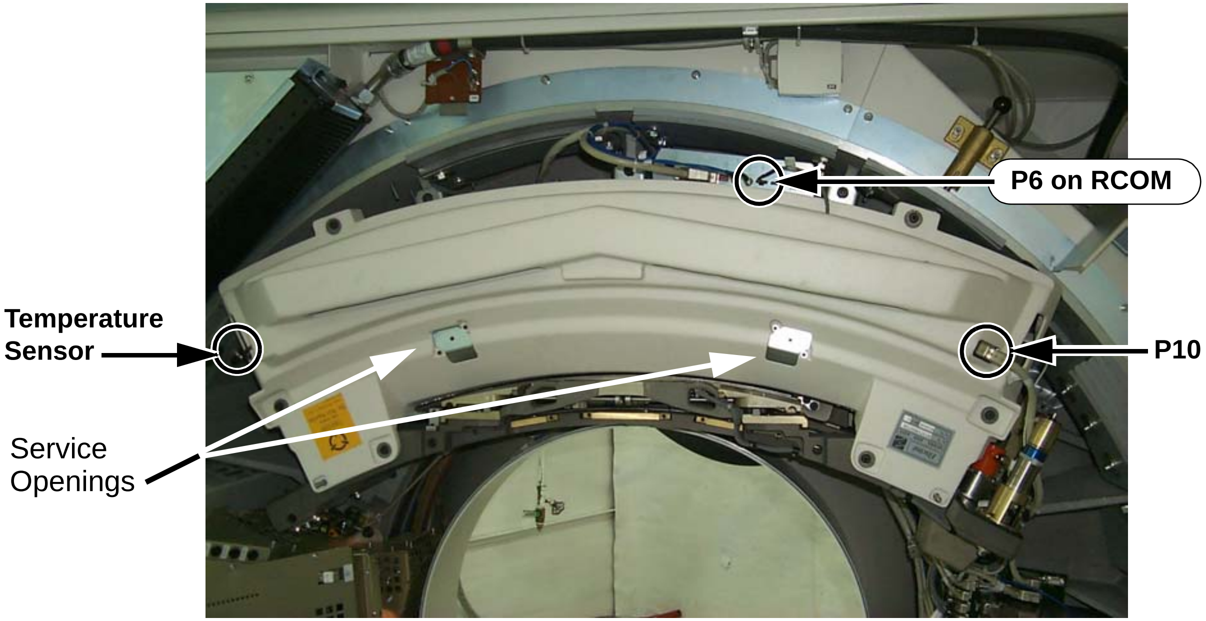


Figure 3-144: Connectors to Open when Removing the Cover of the DMS

Replacing the Cradle Assembly

To replace the cradle assembly, do the following:

1. Remove the cover of the DMS as described in *“Removing the Cover of the DMS”*.
2. Loosen the screws that connect the flexible/rigid cable to the detector modules.
3. On each GI card, open the two screws that hold the connector in place. Then, use the GI connector extract tool (P/N 479-7181-5007) to disconnect the connector from the GI card (see *Figure 3-145*). Let the connectors dangle from the detector modules as shown in *Figure 3-146*.
4. Use a marker pen to write on each detector module its position in the cradle (from 1 to 42, where 1 is to the right of the cradle when it is in the 12 o’clock position).

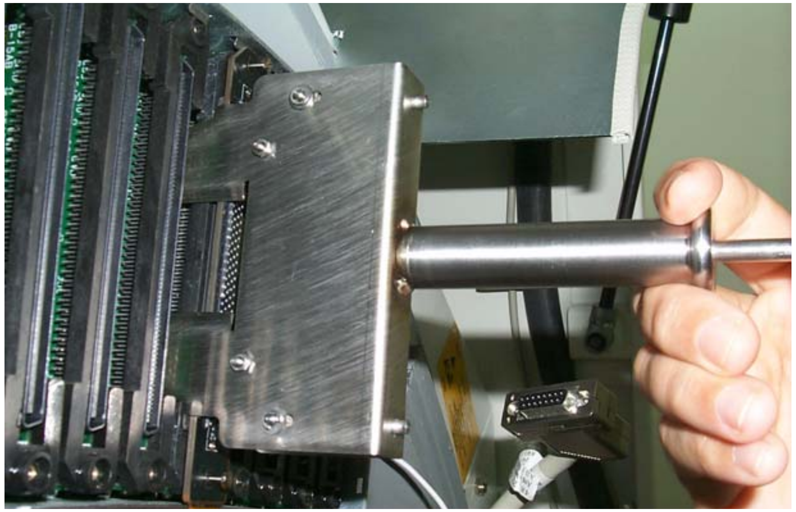


Figure 3-145: Disconnecting the Connector from the GI Card

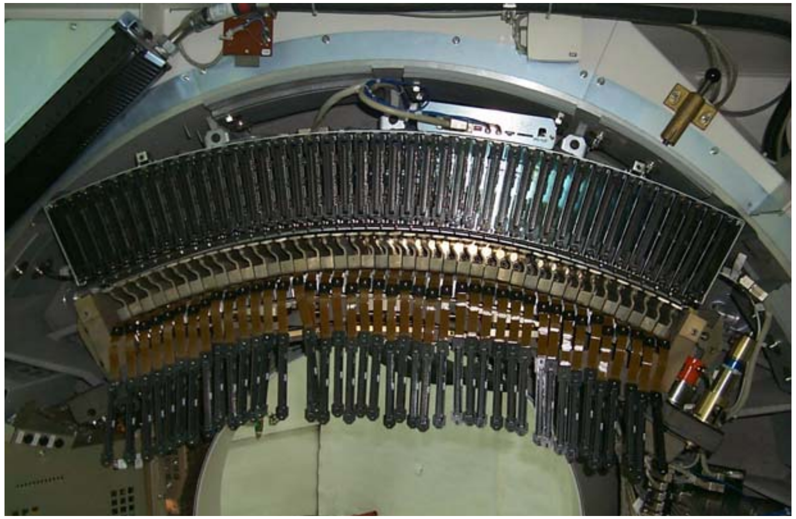


Figure 3-146: Connectors Dangling from Detector Modules

5. Remove all detector modules from the cradle by doing the following for each:
    a. Open the screw using a 5 mm Allen key, as shown in *Figure 3-147*.
    b. Remove the detector modules.

NOTE:

Before you can remove detector module number 1, you must remove detector module number 2. In the same way, before you can remove detector module number 42, you must remove detector module 41.

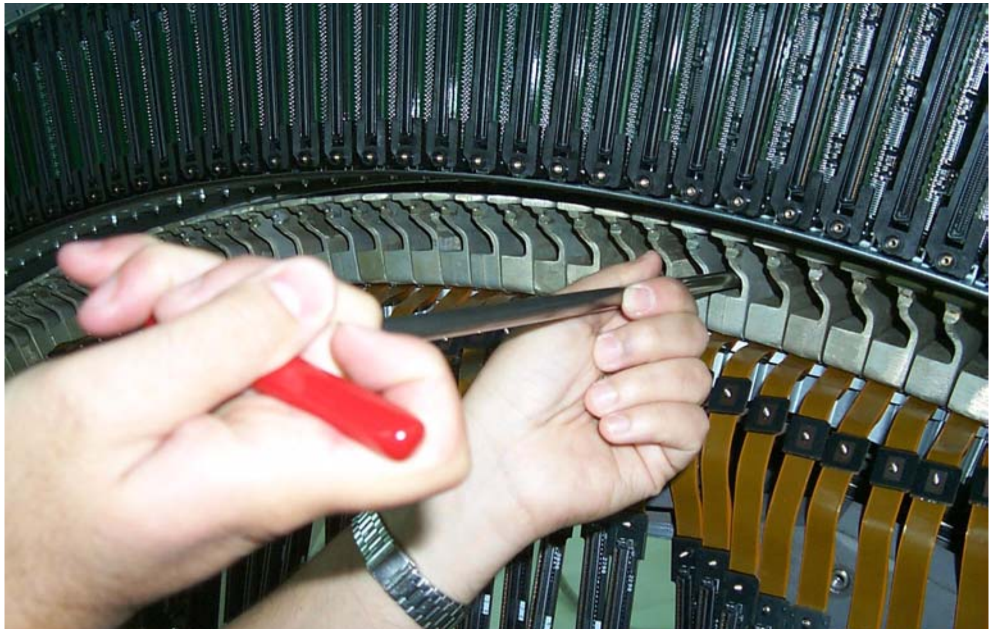


Figure 3-147: Opening the Screw to Remove a Detector Module

    c. Put the detector modules aside where they will not get damaged or dirty, and arrange them in order of their position in the cradle, from 1 to 42.

6. Disconnect the cables connected to the cradle as follows:
   a. On the left side, disconnect the ground cable from the cradle and remove it (see *Figure 3-148*).
   b. On the left side, disconnect the temperature sensor connector and open the cable tie screw that secures the cable to the cradle (see *Figure 3-148*).
   c. On the right side, disconnect the ground cable from the cradle and remove it.
   d. On the right side, cut the cable tie that holds the reference detector cable and the cover fans power cable to the cradle.

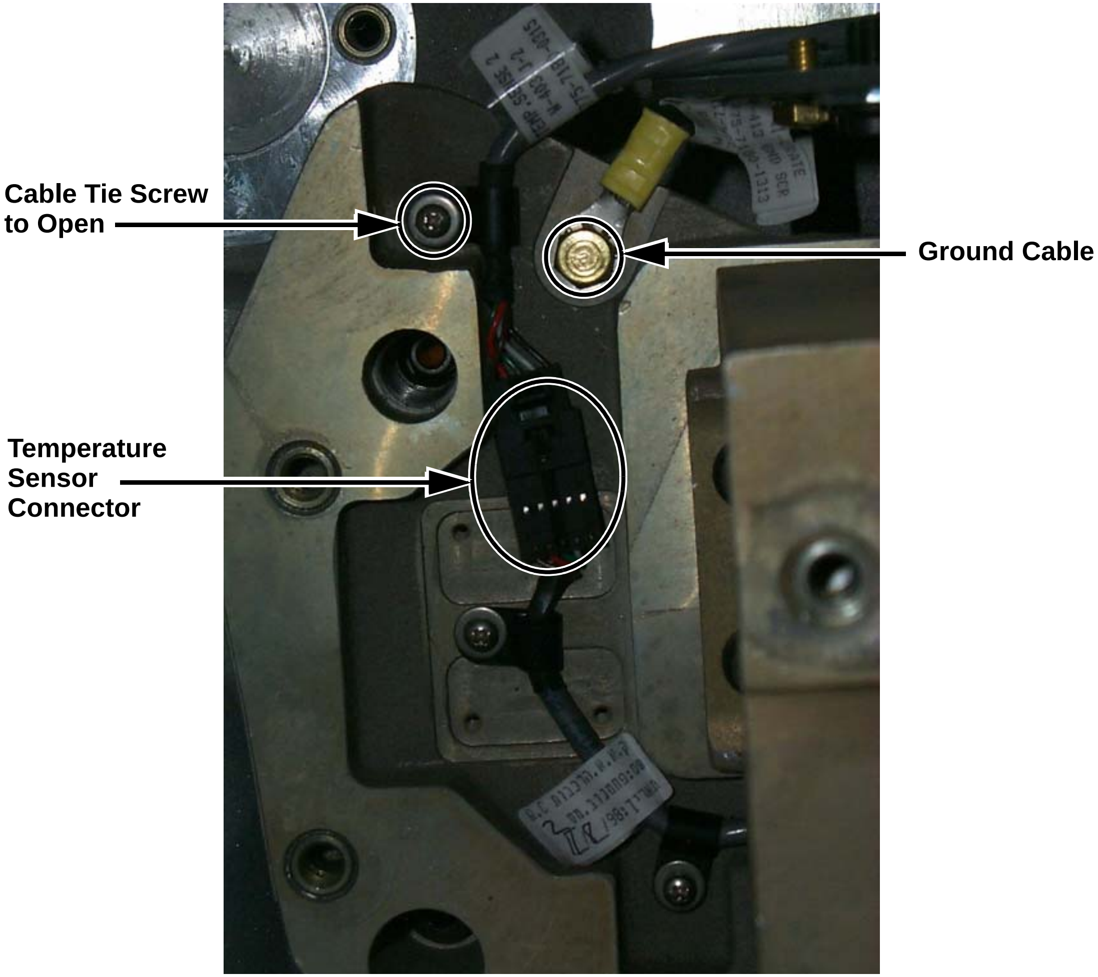


Figure 3-148: Cable Connections on the Left Side of the Cradle

   e. On the C-Box motherboard, release connectors X3, X5 and X9, and cut all cable ties that hold them. They should now be connected only to the cradle.

7. Use a 6 mm Allen key to open the four screws that hold the cradle to the rotor (see *Figure 3-149*).
8. Carefully, so as not to damage the rotor laser marker, have two men pull the cradle forward (towards you) until it is released from the rotor.
   Place the cradle in a safe place.
9. Unpack the new cradle and place it in its correct position on the rotor. Notice that there are two pins to help you guide the cradle to its correct place (see *Figure 3-150*). Make sure the cradle is adjacent to the surface of the rotor.
10. Insert the four screws that secure the cradle in its position and tighten them with a torque of 39 Nm.

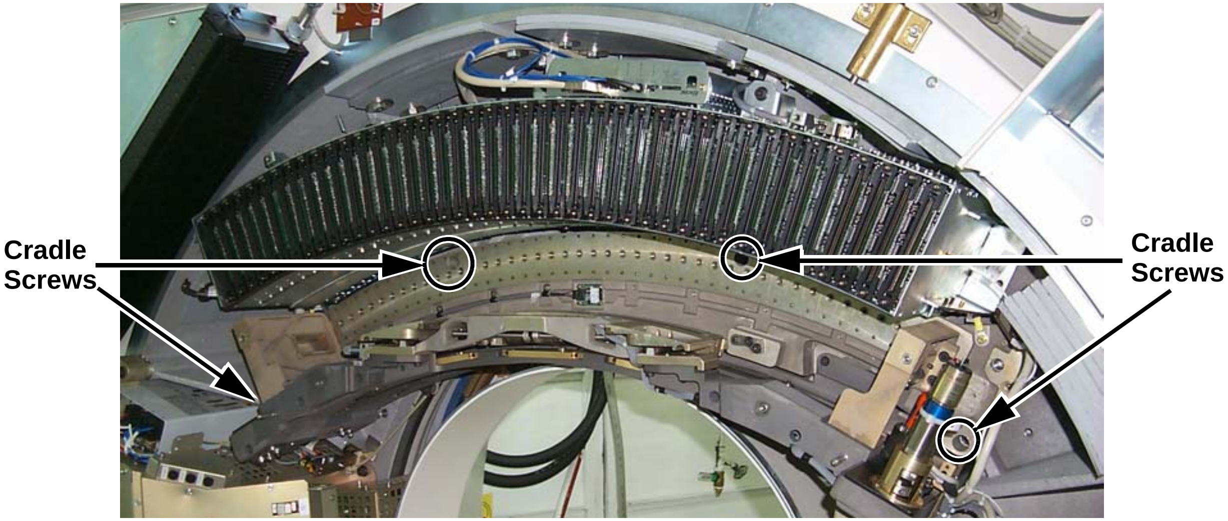


Figure 3-149: The Four Screws that Hold the Cradle to the Rotor

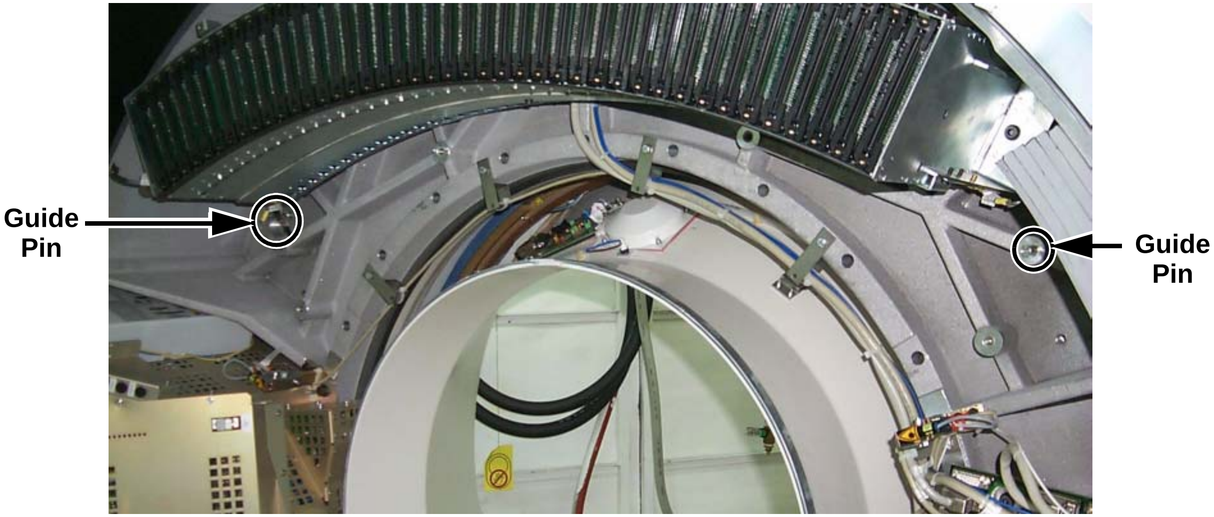


Figure 3-150: Pins to Guide the Cradle into Position

11. Return all 42 detector modules to their original places, in the following order: 1, 42, 21, then one on each side of 21 alternately, i.e., 20, 22, 19, 23 and so on, until all the detector modules are in place.
12. For each detector module, do the following:
    a. Check the number marked on each detector module to make sure you return each to its original position.
    b. Secure the detector module in place with a torque of 20 Nm.
    c. Connect each detector module to the GI cards and torque the connector screws to 40 Ncm.
    d. Torque the screws that connect the flexible/rigid cables to each detector module to 40 Ncm.
13. Reconnect all the cables to the cradle, as follows:
    a. On the left side, connect the ground cable.
    b. On the left side, connect the temperature sensor connector and secure the cable to the cradle.
    c. On the right side, connect the ground cable.
14. Use a cable tie to secure the reference detector cable and the cover fans power cable to the cradle.
15. Connect the three connectors (X3, X5 and X9) from the cradle to the motherboard of the C-Box and route the cables along their paths using cable ties.
16. Close the cover of the DMS and tighten the screw with a torque of 20 Nm using a 5 mm Allen key.
17. Reconnect the cover connectors as follows:
    a. Reconnect the temperature sensor connector (P6 to the RCOM card).
    b. Reconnect the temperature sensor connector on the left side of the cover.
    c. Reconnect the power connector for the fans (P10 on the right side of the cover).
18. Release the locking device of the rotor.
19. Enter the new encoder settings as described in*“Entering New DMS Encoder Settings”*.

Replacing the P-Plane Motor

The estimated time required to replace the P-Plane motor is 1 hour.

Disassembly of the Old Motor

To replace the P-Plane motor, do the following:

1. Position the DMS at the 12 o’clock position.
2. Lock the rotor in position.

⚠ WARNING

TURN THE GANTRY OFF.

3. Rotate the old motor by hand with the extended axis (near the electrical connections—*Figure 3-151*) until the coupling screws appear in the service opening of the base (see *Figure 3-152*).

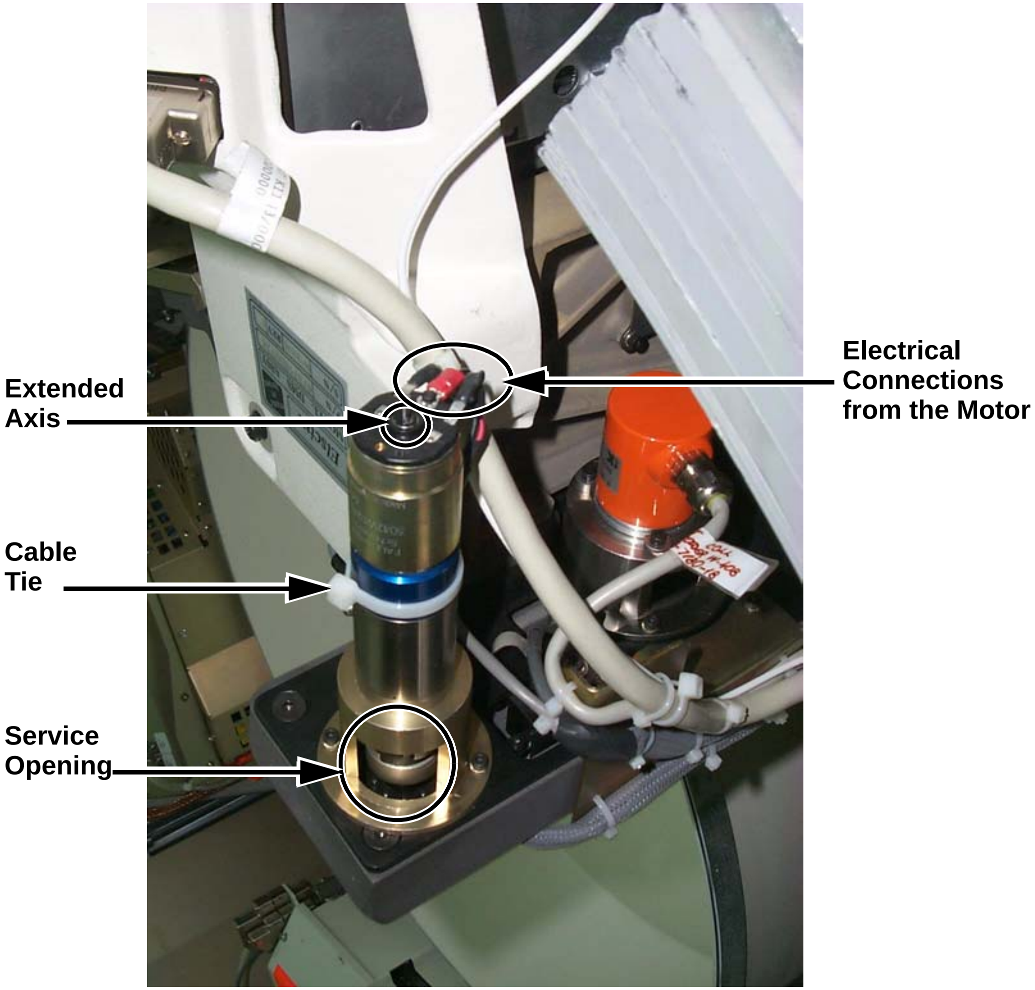

Extended
Axis
Cable
Tie
Service
Opening
Electrical
Connections
from the Motor

Figure 3-151: The Old P-Plane Motor

4. Disconnect the electrical connections (shown in *Figure 3-151*) from the motor using a soldering iron and a screw driver, and cut the cable tie that holds the cable to the motor (shown in *Figure 3-151*).
5. Cut the ground wire; it is not needed for the new motor assembly (see *Figure 3-153*).
6. Release the coupling screw that is closest to the motor using a 2.5 mm Allen key (see *Figure 3-152*).
7. Open the three screws that connect the base of the motor to the P-Plane assembly with a 2.5 Allen key.
8. Pull the motor and its base away from the P-Plane assembly.

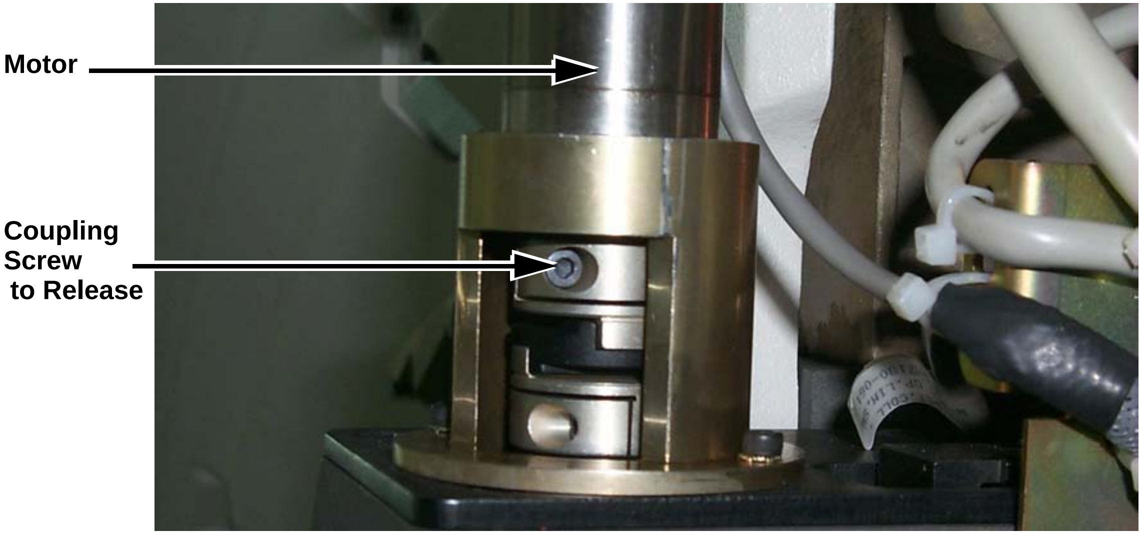


Figure 3-152: Coupling Screw Closest to the P-Plane Motor

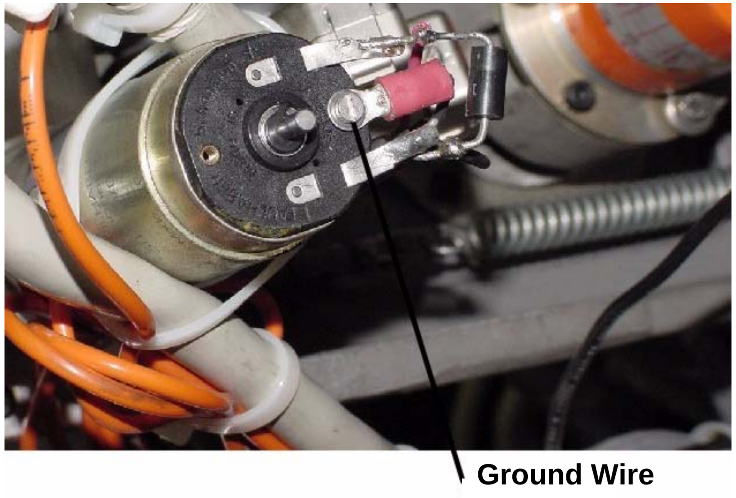


Figure 3-153: Old Motor

Assembly of the New Motor

1. Position the adapter and the motor gear on the P-Plane assembly so that you can access the coupling screws (see *Figure 3-154*). Insert the axis of the motor into the coupling. Tighten the three screws and lock washers that connect the adapter to the P-Plane assembly with a torque of 100 Ncm (see *Figure 3-154*).
2. Tighten the coupling screws with a torque of 100 Ncm.
3. Solder the electrical connections of the motor and secure the cable to the motor using a cable tie.

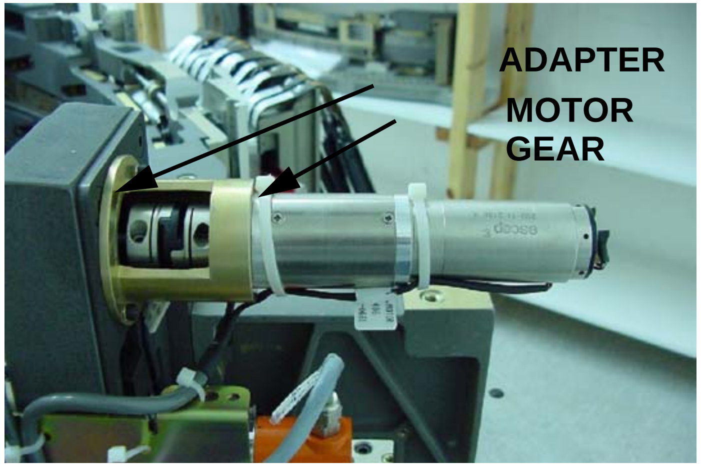


Figure 3-154: The New P-Plane Motor

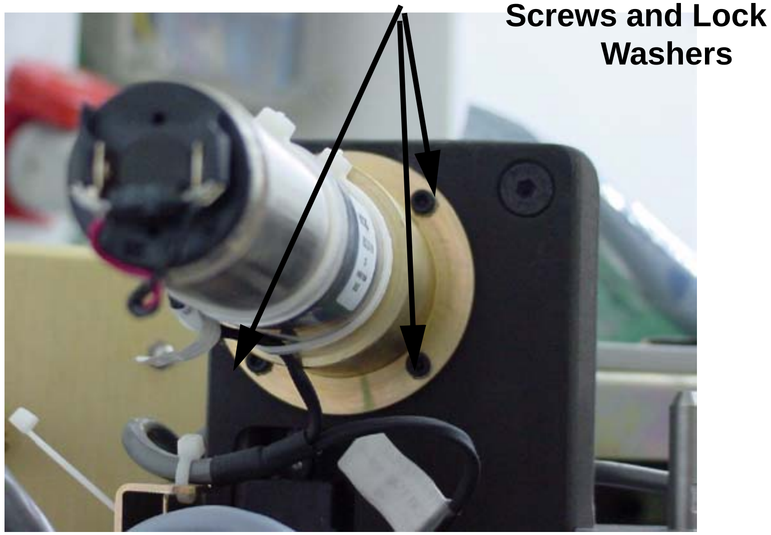


Figure 3-155: The New P-Plane Motor—P-Plane Connecting Screws

Testing the Detector Collimator Movement—Examination of the Proper Functioning of the New Motor

1. Turn the Gantry ON.
2. Bring the system to STBY.
3. Turn the service switch **S301** on the Gantry to 0 (zero).
4. On the Delphi board (D515), use the service switch to test movement of the collimator as follows:
   a. Set the service switch **S1** on the Delphi board to ON (1).
   b. Press service switch **S2** to move the collimator in.
   c. Press service switch **S3** to move the collimator out. Observe movement in both directions.
   d. Upon completion of the examination, unlock the rotor and turn service switch **S1** to OFF.

Replacing the Encoder of the P-Plane

After installing the new encoder of the P-Plane, you have to calibrate P-Plane stops. The following sections describe how to perform these tasks.

Installing the New Encoder

Install the new encoder of the P-Plane as follows:

1. Position the DMS at the 6 o'clock position.
2. Remove the mylar of the P-Plane using a 2 mm Allen key, as follows:
3. Open the twelve screws that hold the mylar.
4. Remove the mylar and the two PVC strips, and place it on a flat surface. Be careful not to drop any screws.
5. On the DELPHI card, change the setting of S1 to service (SER).
6. Use the **Open/Close** buttons to move the P-Plane to an open position in which the outer blade of the collimator (the one furthest from you) is tangent with the opening of radiation in the aluminum cast.
7. Confirm that the position is correct by using a jig as shown in *Figure 3-156*.

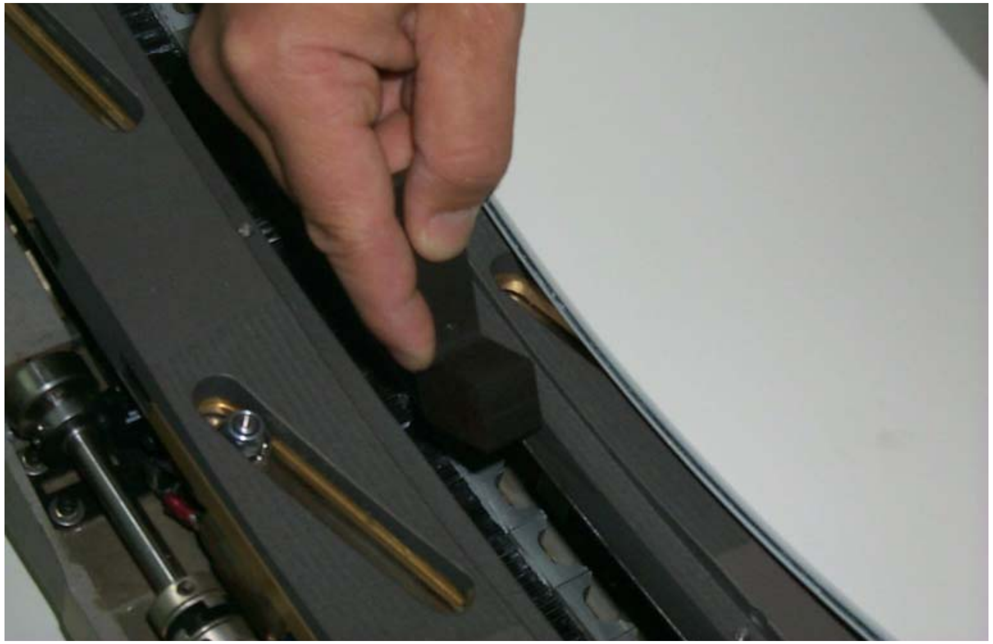


Figure 3-156: Using a Jig to Verify the Position of the Collimator Blade

8. Position the DMS at the 12 o'clock position.
9. Position the coupling screws opposite the service opening of the encoder base by rotating the motor by hand using the extended axis of the motor that is near the electrical connections of the motor (shown in *Figure 3-157*).
10. Open the encoder cable from the C-Box side (X3 on the C-Box back plan) and release the cable from the cable ties that hold it.
11. Loosen the screw that holds the axis of the motor in the coupling. Open the screw that is closest to the encoder.
12. Loosen the three screws that connect the encoder to its base and turn the semi-circular washers to release the encoder using a 2.5 mm Allen key
13. .Pull the encoder out of its base.

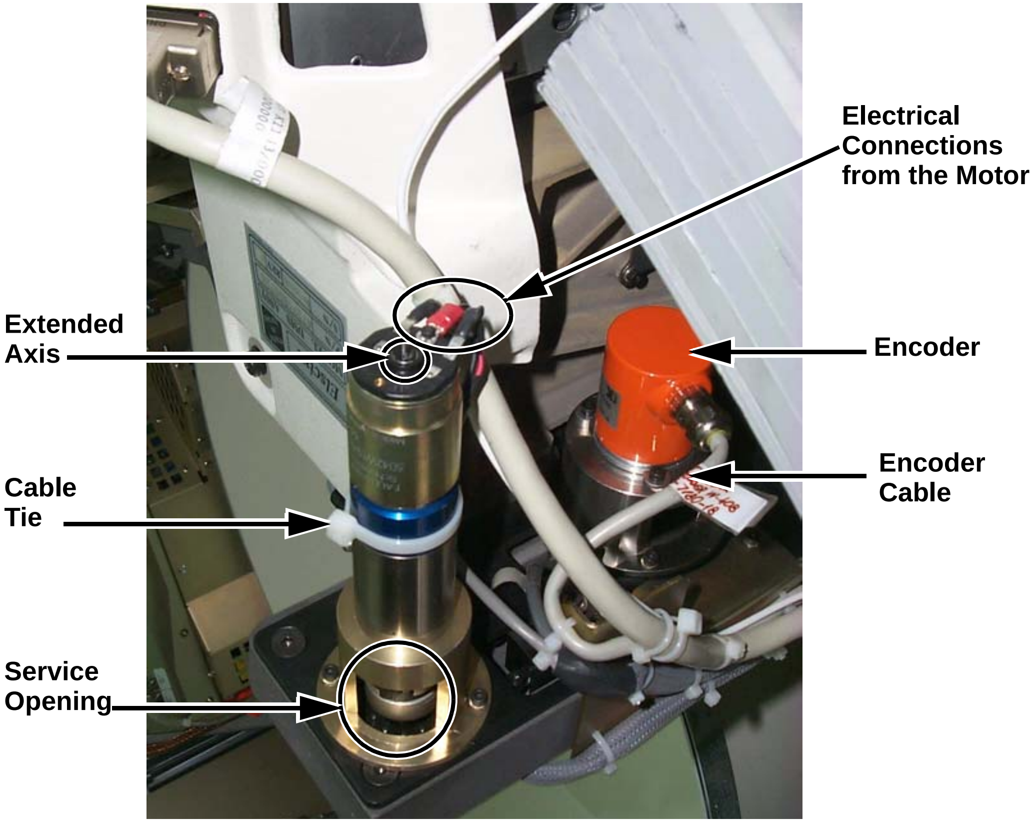


Figure 3-157: Correct Encoder and Encoder Cable Position Relative to Motor

14. Connect the connector of the new encoder to the C-Box (X3).
15. Position the new encoder so that its cable faces the metal plate on the outside of the DMS, as shown in *Figure 3-157*.
16. Turn the axis of the encoder by hand until the **Index** LED on the DELPHI card flashes ON. (It goes OFF right away.) Without moving the shaft of the encoder from the Index position, insert the shaft into the coupling.
17. Secure the new encoder in place using the three screws and semi-circular washers that you loosened in step 12.
18. Close the coupling screw with a torque of 80 Ncm using a 2 mm Allen bit.

19. Route the cable of the new encoder on the plate, using the same path used for the cable of the old encoder. Secure the cable in position with cable ties.
20. Loosen the encoder and turn it very gently, by hand, until the Index LED on the DELPHI card is ON. Secure the encoder in this position using the three semi-circular washers and the screws. Tighten the screws using a torque of 100 Ncm.

Calibrating P-Plane Stops

To calibrate P-Plane stops, you find and record the specific hexadecimal encoder readings, verify those readings and record the decimal equivalents in the host computer.

Getting Ready

Prepare to calibrate P-Plane stops as follows:

1. Use CanPro software to bring the machine to the **Init Done (ID)** stage.
2. Use an RS232 communication cable to connect the laptop computer or PC to the DELPHI card.

NOTE:

Make sure you disable the rotation (S301 in zero position).

3. Open a monitor on the computer.
4. Verify that you are connected to the DELPHI card by typing **CS** and pressing **<Enter>**.
5. The following should appear: ".......Board is Delphi".
6. On the DELPHI card, change S1 to service (SER) and close the collimator to fit the 30 mm jig.

NOTE:

- Never close the collimator while the jig is in the collimator opening. Always remove the jig before closing the collimator, and then use the jig to check again.
- You must approach the correct setting from the open position, moving towards the closed position. If you close the collimator too much, open it more than necessary and approach the correct position again.
- The collimator is in its correct position only when the Go portion of the jig is inside the opening and the NoGo portion is outside the opening. Do not force the jig into the collimator opening. It should fit easily.
- Check the opening only in the middle of the P-Plane.

Finding and Recording Hexadecimal Encoder Readings

To find and record hexadecimal encoder readings, do the following:

1. On the monitor of the computer, type **PP 0 BB8**, and press **<Enter>**.
2. The following line is displayed:
3. **POS 0 APERTURE 0xBB8 ENCODER 0xyyy**
4. Record the **yyy** hexadecimal value in *Table 3-36*, in the **Encoder Reading (Hex)** column, on the line for a 30 mm jig opening.

Table 3-36: Encoder Readings

OPENING IN MM (JIG SIZE)	ENCODER READING (HEX)	ENCODER READING (DEC)
30		
15		
6		
2		

5. From the DELPHI card, adjust the collimator to the 15 mm jig.
6. On the monitor of the computer, type **PP 1 5DC**, and press **<Enter>**.
7. The following line is displayed:
   POS 1 APERTURE 0x5DC ENCODER 0xvvv
8. Record the **vvv** hexadecimal value in *Table 3-36*, in the **Encoder Reading (Hex)** column, on the line for a 15 mm jig opening.
9. From the DELPHI card, adjust the collimator to the 6 mm jig.
10. On the monitor of the computer, type **PP 2 258**, and press **<Enter>**.
11. The following line is displayed:
12. **POS 2 APERTURE 0x258 ENCODER 0xwww**
13. Record the **www** hexadecimal value in *Table 3-36*, in the **Encoder Reading (Hex)** column, on the line for a 6 mm jig opening.
14. From the DELPHI card, adjust the collimator to the 2 mm jig.
15. On the monitor of the computer, type **PP 3 C8**, and press **<Enter>**.
16. The following line is displayed:
17. **POS 3 APERTURE 0xC8 ENCODER 0xzzz**
18. Record the **zzz** hexadecimal value in *Table 3-36*, in the **Encoder Reading (Hex)** column, on the line for a 2 mm jig opening.

Verifying Hexadecimal Encoder Readings and Recording Decimal Equivalents

Verify the hexadecimal encoder readings and record the decimal equivalents in the host computer as follows:

1. Type **CS**, and press **<Enter>**.
2. Type **SF**, and press **<Enter>**.
3. Type **SF** a second time, and press **<Enter>**.
4. Type **PR**, and verify that the display is identical to the **Encoder Reading (Hex)** column of *Table 3-36*.
5. Use a calculator to convert the hexadecimal values to decimal format and enter them in the **Encoder Reading (Dec)** column of *Table 3-36*.

Entering Encoder Readings into the Host

Use the settings recorded in *Table 3-36* to update T9B.TSC in the host computer as described below.

6. In the host, open a ***winterm*** window.

> **NOTE:**
>
> Case is significant in this procedure. Type paths and file names exactly as shown.

7. At the system prompt, type **cd /usr/diamond.root/tbl/MCUtbl/Tabmake** and press **<Enter>**.
8. Type **ls** and press **<Enter>**. The MCU tables and files are listed. Notice the **TabMake**, **bin** and **CanTab.list** files, which you will use later.
9. Type **jot CanTab.list** and press **<Enter>**. This displays a list of all tables with the # symbol attached.
10. Remove the # symbol from the **T9B.TSC** line. Verify that all other lines have the # symbol. (If any line is missing a # symbol, insert it.)
11. Save and exit.
12. At the system prompt, type **cp T9B.TSC T9B.OLD** and press **<Enter>**. This creates a backup of the current file, which you need, if you make an error.
13. Type **jot T9B.TSC** and press **<Enter>**. The text is displayed. (See *Figure 3-158*; the values shown are examples only.)

```
#CANPRO Scenario
#Project P20
#T9B DLP Detector Collimator Parameter

send 0x00 T 0x9B 0x01 0x03 0xCD  0x75  0x30  0x00
listen 0.1
send 0x00 T 0x9B 0x01 0x10 0x0B  0x3A  0x98  0x01
listen 0.1
send 0x00 T 0x9B 0x01 0x17 0xAF  0x17  0x70  0x02
listen 0.1
send 0x00 T 0x9B 0x01 0x1A 0xFC  0x07  0xD0  0x03
listen 0.1
send 0x00 T 0x9B 0x00 0x00 0x00 0x00 0x00  0xFF
listen 0.1
```

Figure 3-158: The T9B Text File

14. Modify the text of the table. Replace the **EnH** and **EnL** values in each line with the appropriate hex values from *Table 3-36* where **EnH** is the high byte, and **EnL** is the low byte according to the following format:

    send 0x00 T 0x9B 0x01 0x**EnH** 0x**EnL** 0xOpH 0xOpL

The first line in T9B refers to the 30 mm station, the second line refers to the 15 mm station, the third line refers to the 6 mm station, and the fourth line refers to the 2 mm station.

15. Save and exit.
16. Type **./TabMake** and press **<Enter>**. This compiles the file and saves it as **T9B** in the **/bin** directory.
17. Type **cd bin** and press **<Enter>**.
18. Type **cp T9B ../../tables** and press **<Enter>** to copy the file to the **/tables** directory.
19. Check the date and time of the **T9B** file in the **/tables** directory to make sure that it has been updated.
20. Switch the Gantry OFF.
21. Log out, switch the Gantry ON and log in.

P-Plane Collimator Host Table Set-up

The P- Plane collimator encoder settings for each system cradle are specified in the P- Plane Collimator document that is shipped with the system, P/N 451-7180-0506 (in the envelope with the DMS, Data Measuring System).

The procedure in this section describes how to process these settings and enter them in the table in T9B.TSC (the DLP Detector Collimator table).

Validity

Use this procedure during initial integration, or in any of the following cases:

- The cradle is replaced (A new P- Plane Collimator document is provided)
- Host system tables are corrupted, and no backup is available
- The P-Plane encoder is replaced

Procedure

During initial integration, or in the field whenever you have to update the P-Plane collimator settings, use the procedure described here:

1. In *Table 3-37*, the openings for the four stations, and the low (OpL) and high (OpH) bits of their hexadecimal equivalents, are already entered as: 30 mm, 15 mm, 6 mm, and 2 mm.

Table 3-37: DLP Detector Collimator Table

STATION OPENING			ENCODER MEASUREMENT (PULSES)		
MM	HEXADECIMAL		DECIMAL	HEXADECIMAL	
	LOW BITS (OPL)	HIGH BITS (OPH)		LOW BITS (ENL)	HIGH BITS (ENH)
30	75	30			
15	3A	98			
6	17	70			
2	07	D0			

2. Open the P-Plane collimator document (P/N: 451-7180-0506). (Look in the envelope you received with the DMS.)

   Enter the Encoder Measurement values specified in the document for your system into the **Decimal** column of *Table 3-37* under the heading **Encoder Measurement (Pulses)**.
3. Convert these decimal values to hexadecimal format, and write the low bits (EnL) and the high bits (EnH) into the appropriate columns.
4. Modify the T9B table in the host computer as follows:
   a. Verify that you are logged on to the system. If not, log on as **Mx8000**.
   b. From **Service** in the main menu, enter **MCU Utilities | Edit Tables | Update Tables**.

   c. Select T9B table and click **OK**.
   d. Change the underlined and bold fields as shown below:

```
send 0x00 T 0x9b 0x01 0x03 0xcd 0x75 0x30  0x00 listen 0.1
send 0x00 T 0x9b 0x01 0x10 0x0b 0x3a 0x98  0x01 listen 0.1
send 0x00 T 0x9b 0x01 0x17 0xaf 0x17 0x70  0x02 listen 0.1
send 0x00 T 0x9b 0x01 0x1a 0xfc 0x07 0xd0  0x03 listen 0.1
send 0x00 T 0x9b 0x00 0x00 0x00 0x00 0x00  0xff  listen 0.1
```

   e. Click **Update** and **Exit**.

5. Logout and then login for the changes to take effect.

Replacing the Optical Switch of the P-Plane

Use the following procedure to replace the optical switch of the P-Plane:

1. Position the DMS at the 6 o’clock position.
2. Open the three screws that secure the cover of the optical switch in place, using a 2.5 mm Allen key and remove the cover.
3. Disconnect the small electrical connector from the PCB of the optical switch.
4. Open the two screws that secure the metal plate (that has the optical switch on it) to the P-Plane assembly (see *Figure 3-159*).

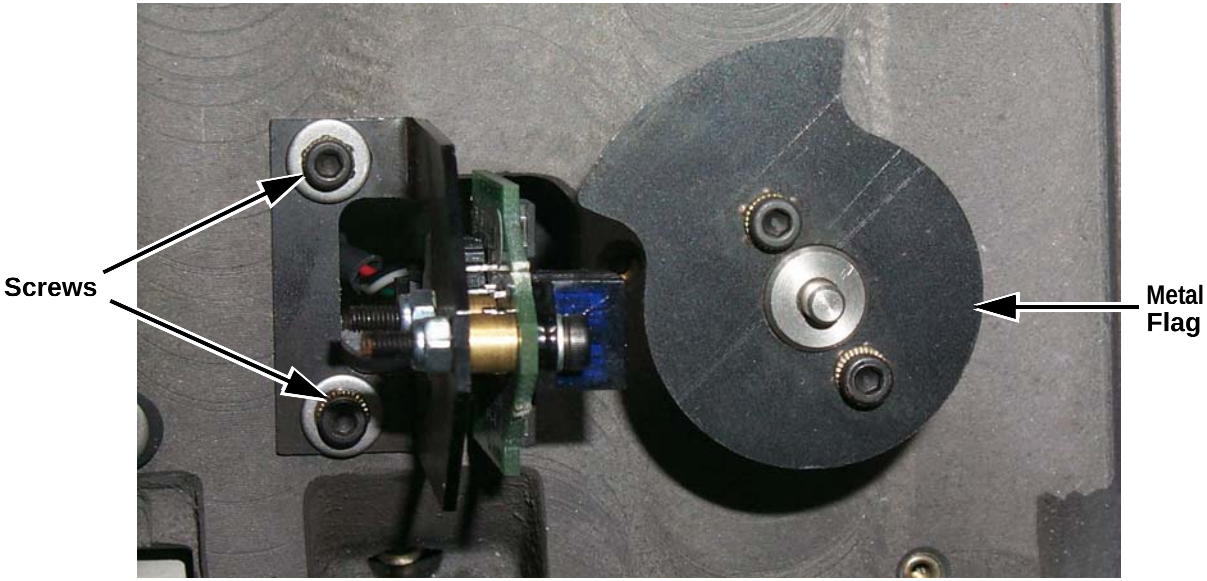


Figure 3-159: Optical Switch on Its Metal Plate

5. Remove the PCB from the metal plate. Open the screws that hold the PCB in place, using a 2.5 mm Allen key, and a 6 mm hex bit and ratchet.
6. Install the new PCB on the metal plate and tighten the two screws with a torque of 100 Ncm. Remember to include the spacers, as shown in *Figure 3-160*.

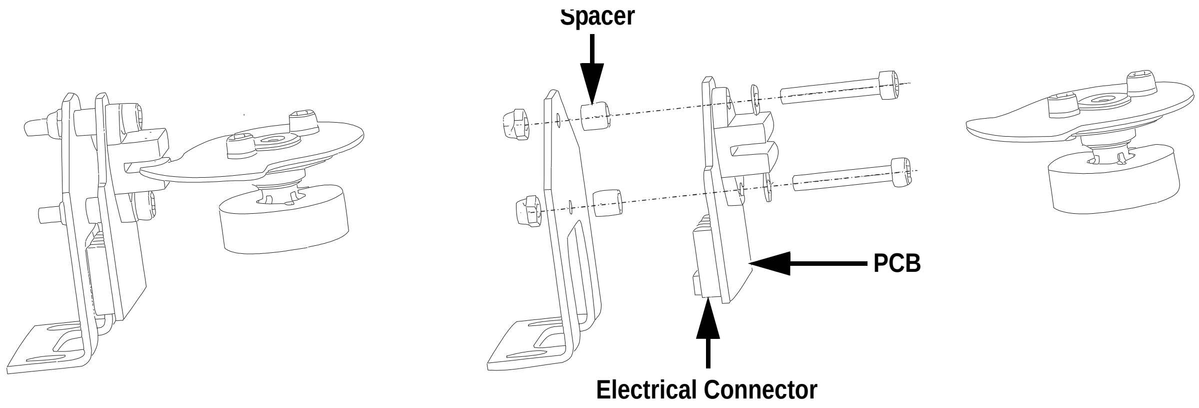


Figure 3-160:

7. Return the PCB and metal plate to their previous positions on the cradle. Do not tighten the screws yet.
8. Connect the electrical connector to the new optical switch.
9. Release the metal flag from its shaft by loosening the coupling screw using a 3 mm Allen key, and rotate the flag until it faces the optical switch. Make sure the metal flag is 1 mm from the edge of the optical switch as shown in *Figure 3-161*. If the metal flag is not 1 mm from the edge of the optical switch, move the metal plate until it is in its correct position (see *Figure 3-161*) and secure it in place with a torque of 100 Ncm.
10. Remove the mylar of the P-Plane as follows:
    a. Open the twelve screws that hold the mylar using a 2 mm Allen key.
    b. Remove the mylar and the two PVC strips.

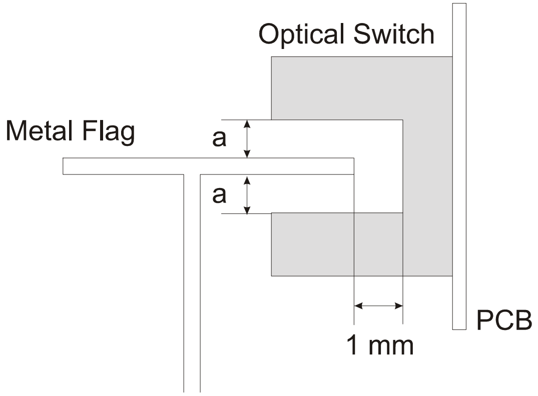


Figure 3-161: Correct Position for Metal Flag Relative to Optical Switch

11. On the DELPHI card, switch to the service setting, close the P-Plane to a 1 mm opening (use a 1 mm jig) so that the **Go** part fits inside the collimator and the **NoGo** part remains outside of the collimator opening.

NOTE:

Do not put the jig between the collimator blades when you close the collimator. Check with the jig only when the blades are not moving.

12. When you close the collimator, hold the metal flag by hand to keep it out of the optical switch. Then, manually rotate the metal flag clockwise (CW) on its shaft, until the Limit LED (LIM) on the DELPHI card is ON.
13. Make sure that the metal flag is midway between the top and bottom of the optical switch as shown by distance "a" in *Figure 3-161*.
14. Lock the screw on the coupling using a torque of 80 Ncm. Make sure that the Limit LED (LIM) is still ON.
15. From the DELPHI card, open the P-Plane as far as it goes until the Limit LED on the DELPHI card is ON. Make sure that the two collimator blades are under the radiation opening of the aluminum cast and are not visible.
16. Reinstall the mylar and the two PVC strips. Tighten the twelve screws with a torque of 60 Ncm.
17. Close the cover of the optical switch and tighten the three screws with a torque of 100 Ncm using a 25 mm Allen bit.

Replacing the P-Plane Mylar

Replace the P-Plane mylar as follows:

1. Position the DMS at the 6 o’clock position.
2. Open the 12 screws that secure the mylar in place, using a 2.5 mm Allen key.
3. Remove the mylar and the two PVC strips.
4. Check that the new mylar is clean and not damaged.
5. Position the new mylar, with the two PVC strips on top of it.
6. Insert the 12 screws and tighten them with a torque of 60 Ncm

Replacing the Cradle Temperature Sensor

Do the following to replace the cradle temperature sensor:

1. Remove the cover of the DMS as described in *“Removing the Cover of the DMS”*.
2. On detector modules 19 through 23, loosen the screws that secure the flexible/rigid cable to the detector module.
3. Loosen the GI connector screws of GI cards 19 through 23 and remove the connector from the GI card using the connector extract tool (shown in *Figure 3-145*).
4. Use a marker pen to write on detector modules 19 through 23 their positions in the cradle.
5. Remove detector modules 19 through 23 using a 5 mm Allen key and put them in a safe place.
6. After you remove the detector modules, you are able to see and access the temperature sensor on the cradle as shown in *Figure 3-162*.
7. Remove the temperature sensor as follows:
    a. Remove the connector from the PCB by pushing the pin and pulling the connector.
    b. Open the four screws that attach the PCB to the cradle.
8. Install the new temperature sensor and close the four screws with a torque of 80 Ncm.
9. Reconnect the connector.
10. Reinstall the detector modules that you removed to their original positions on the cradle. Tighten the screws that secure them in place with a torque of 26 Nm.

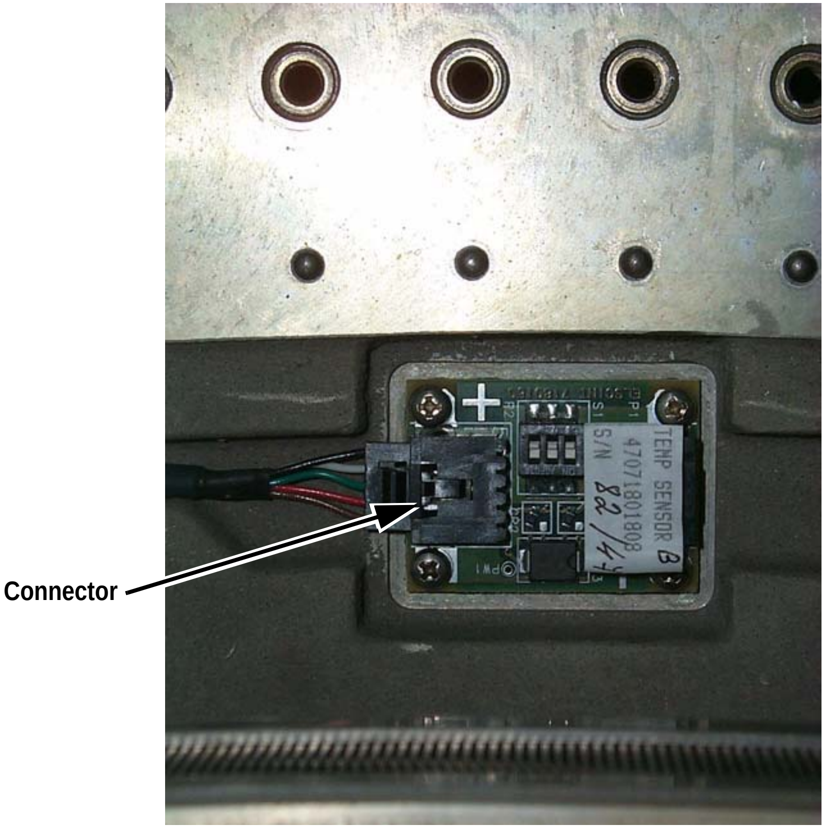


Figure 3-162: Temperature Sensor on the Cradle

11. Connect the connectors to the GI card and tighten the screws with a torque of 15 Nm.
12. Torque the screws that hold the flex/rigid cable to the detector modules to 40 Ncm.
13. Close the cover of the DMS and tighten the screw with a torque of 20 Nm using a 5 mm Allen key.
14. Reconnect the cover connectors as follows:
    a. Reconnect the temperature sensor connector (P6 to the RCOM card).
    b. Reconnect the temperature sensor connector on the left side of the cover.
    c. Reconnect the power connector for the fans (P10 on the right side of the cover).
15. Release the locking device of the rotor.

Replacing GI Cards

To replace a GI card, do the following:

1. Remove the cover of the DMS as described in *“Removing the Cover of the DMS”*.
2. On the GI card you are replacing, open the two screws that secure the connector in place.
3. Use the connector extract tool to remove the GI connector (see also *Figure 3-145*).
4. Connect the GI extract tool to the defective GI card as shown in *Figure 3-163*.

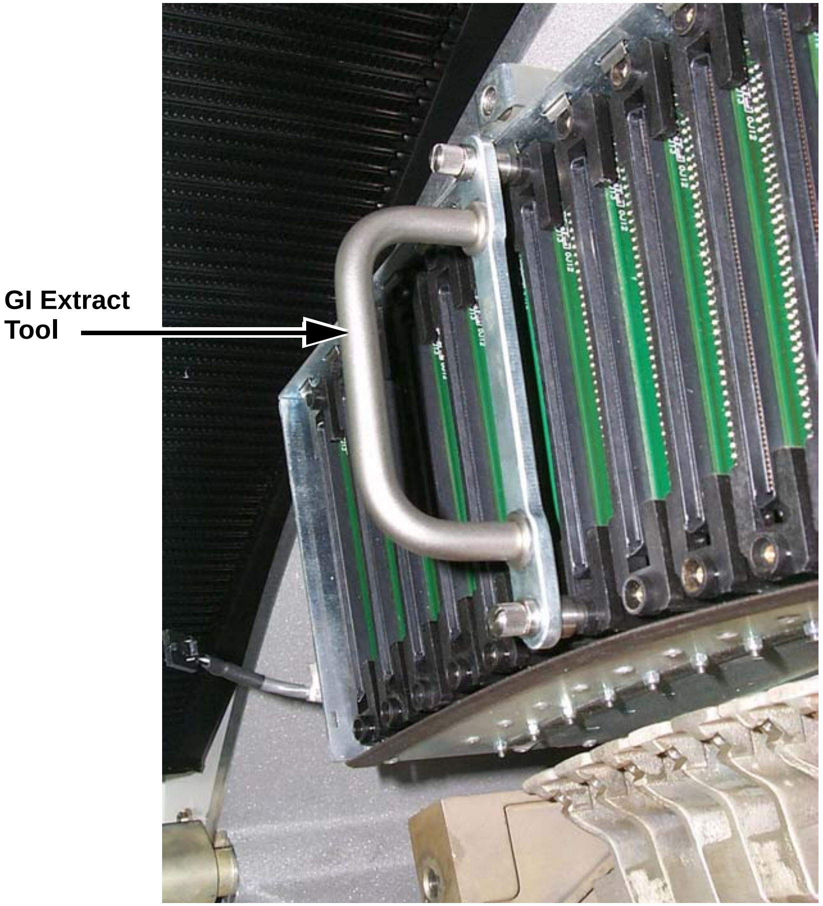


Figure 3-163: GI Extract Tool Connected to a GI Card

5. Using a small screwdriver, raise the clip that holds the GI card in place and pull it using the GI card extractor, as shown in *Figure 3-164*.
6. Insert the new GI card into its place. It must be in its slot and inserted until the clip snaps into place as shown in *Figure 3-165*. Secure the GI card in place.
7. Reconnect the GI connector and tighten the two screws with a torque of 40 Ncm.
8. Close the cover of the DMS and tighten the screw with a torque of 20 Nm using a 5 mm Allen key.
9. Reconnect the cover connectors as follows:
    a. Reconnect the temperature sensor connector (P6 to the RCOM card).
    b. Reconnect the temperature sensor connector on the left side of the cover.
    c. Reconnect the power connector for the fans (P10 on the right side of the cover).
10. Release the locking device of the rotor.

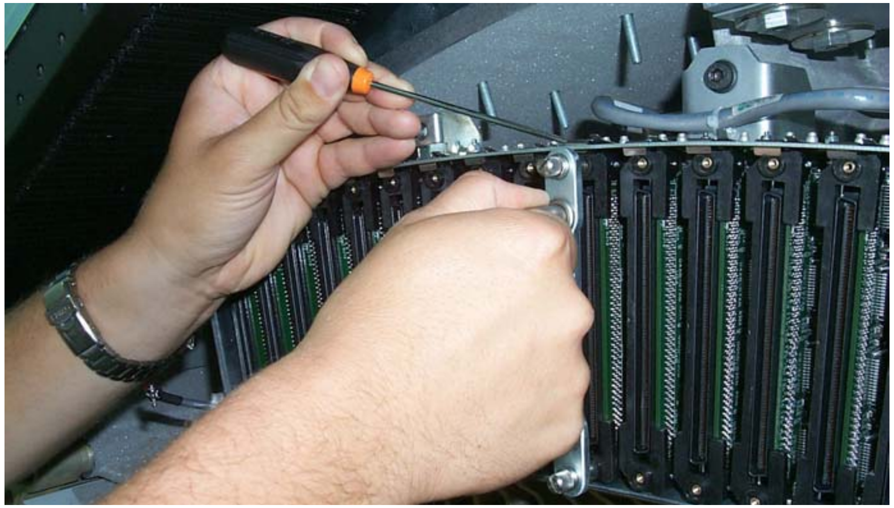


Figure 3-164: Pulling out the GI Card Using the GI Card Extractor

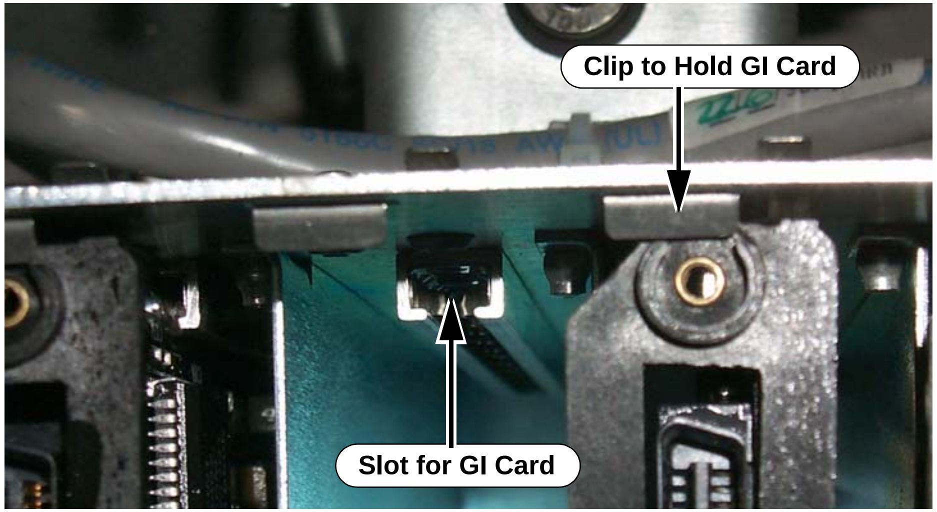


Figure 3-165: Securing the GI Card

Replacing Detector Modules

To replace a detector module, do the following:

1. Remove the cover of the DMS as described in *“Removing the Cover of the DMS”*.
2. On the GI card for the detector module you are replacing, open the two screws that secure the connector in place.
3. Open the screw that secures the flexible/rigid cable to the detector module.
4. Use the connector extract tool to remove the connector from the GI card (see *Figure 3-166*).

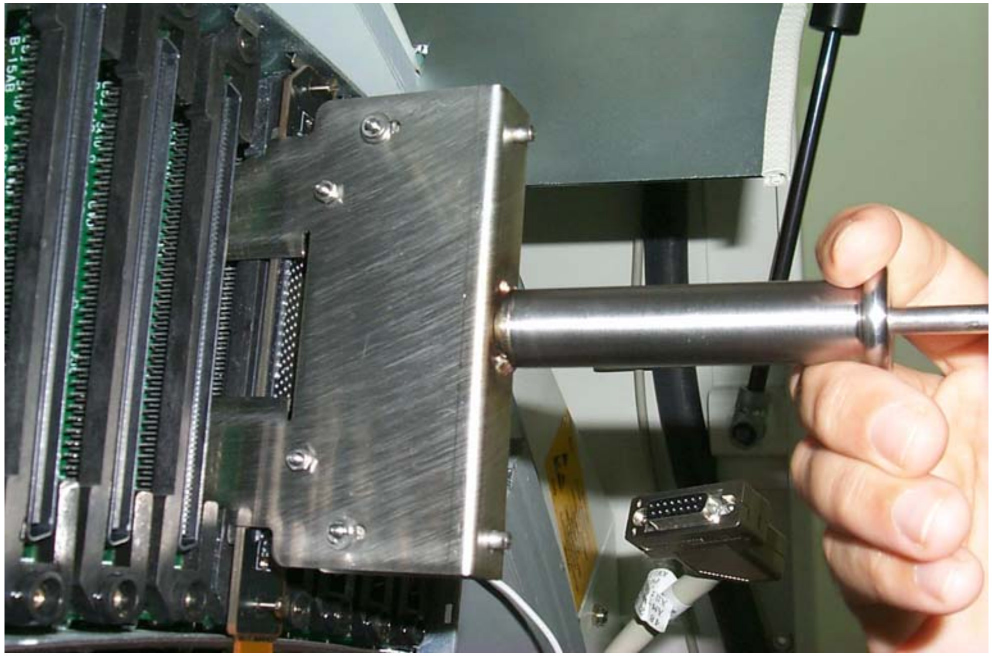


Figure 3-166: Using the Connector Extract Tool to Remove the Connector

5. Remove the defective detector module as follows:
   a. Open the screw that holds the module in place using a 5 mm Allen key.
   b. Gently pull the module towards you until it is out of the cradle and place the module in a safe place.

⚠ CAUTION

DO **NOT** USE FORCE TO REMOVE THE MODULE.

6. Unpack the new detector module and gently slide it into its place. Make sure that the pins on the cradle fit into the space provided for them on the detector module.
7. Lock the module in place by tightening the screw with a torque of 20 Nm.
8. Close the screw that connects the flexible/rigid cable to the module with a torque of 5 Nm
9. Reconnect the GI connector and tighten the two screws with a torque of 40 Ncm.
10. Close the cover of the DMS and tighten the screw with a torque of 20 Nm using a 5 mm Allen key.
11. Reconnect the cover connectors as follows:
    a. Reconnect the temperature sensor connector (P6 to the RCOM card).
    b. Reconnect the temperature sensor connector on the left side of the cover.
    c. Reconnect the power connector for the fans (P10 on the right side of the cover).
12. Release the Locking Device of the Rotor.

Replacing the Cover Temperature Sensors

This section describes how to replace the temperature sensors (Left and Right). The temperature sensors are mounted on each end of the Gantry cover, on the inside of the cover.

Replacing the Left Temperature Sensor

Remove the left temperature sensor as follows:

1. Disconnect the electrical connector (see *Figure 3-167*).
2. Open the four screws using a 2.5 mm Allen key.
3. Remove the old temperature sensor card. Be careful not to lose any of the washers.
4. Place the new temperature sensor card in its place. Make sure there are spacers under the card.
5. Insert the four screws using a flat washer and a safety washer for each. Tighten the screws with a torque of 80 Ncm.
6. Apply Loctite 222 glue to secure the screws.

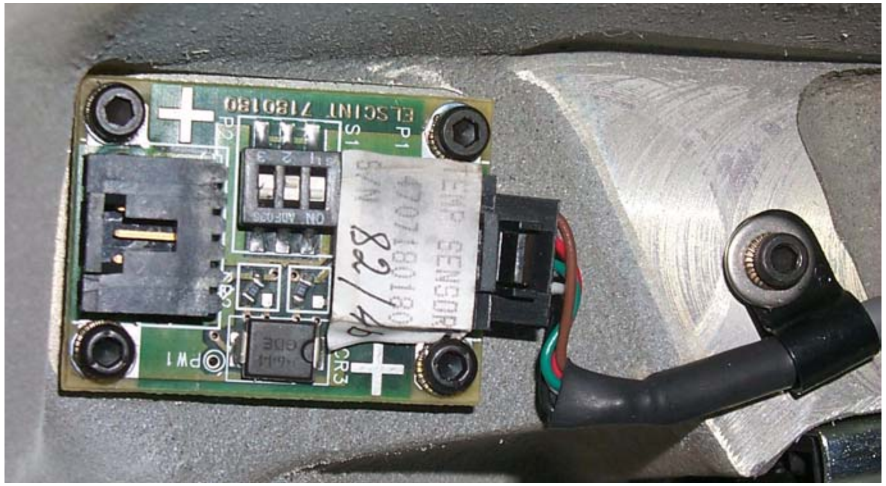


Figure 3-167: Electrical Connector to Left Temperature Sensor

7. Reconnect the electrical connector. Make sure the dip switch position is as shown in *Figure 3-168*.

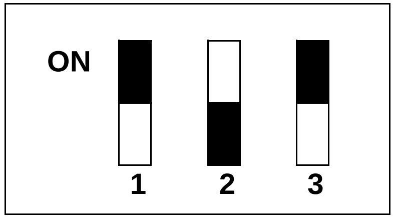


Figure 3-168: Dip Switch Position for Left Temperature Sensor Connector

Replacing the Right Temperature Sensor

Do the following to remove the right temperature sensor:

1. Disconnect the electrical connector (see *Figure 3-170*).
2. Open the four nuts using a hex ratchet.
3. Remove the old temperature sensor card. Be careful not to lose any of the washers.
4. Position the new card so that the dip switch is near the metal bracket as shown in *Figure 3-170*. Make sure the spacers are under the card.
5. Replace the four washers and tighten the four nuts with a torque of 80 Ncm.
6. Reconnect the two connectors. Make sure the dip switch position is as shown in *Figure 3-169*.

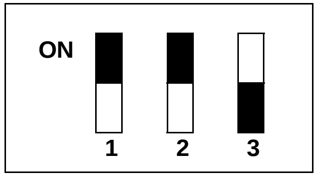


Figure 3-169: Dip Switch Position for Right Temperature Sensor Connector

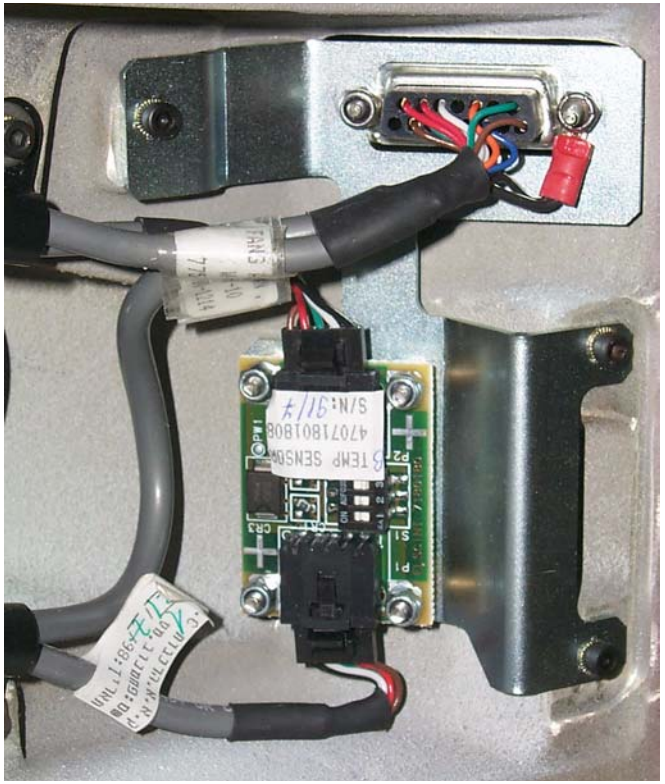


Figure 3-170: Electrical Connectors to Right Temperature Sensor

Replacing the DMS OFF Control Card

Do the following to replace the DMS OFF control card:

1. Remove the cover of the DMS as described in *"Removing the Cover of the DMS"*.
2. Disconnect the electrical connector shown in *Figure 3-171*.

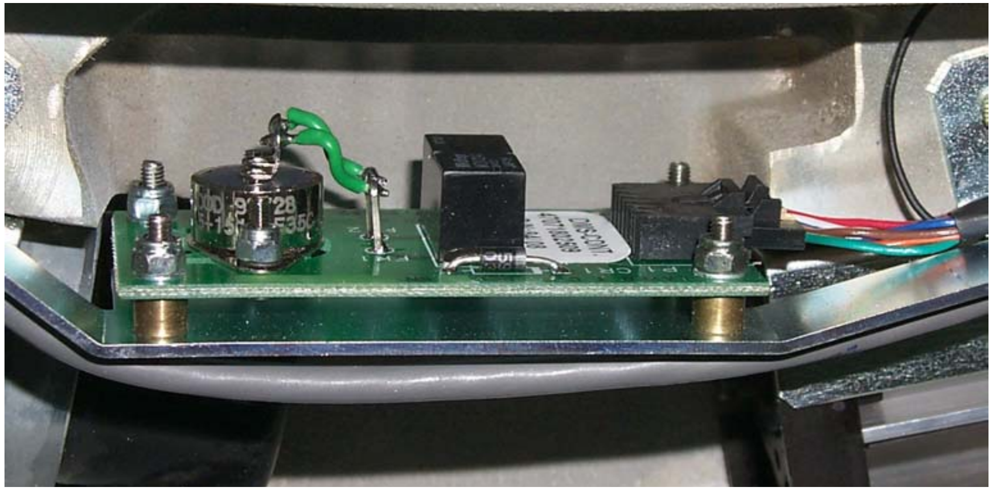


Figure 3-171: Electrical Connector for the DMS OFF Control Card

3. Open the four nuts using a hex ratchet.
4. Remove the old control card. Be careful not to lose any of the washers.
5. Put the new card in its place, paying attention to the position of the connector.
6. Replace the four washers and tighten the four nuts with a torque of 80 Ncm.
7. Reconnect the electrical connector.

Replacing the Fan Power Distribution Board

The following procedure describes replacement of the fan power distribution board:

1. Open the three electrical connectors shown in *Figure 3-172*.

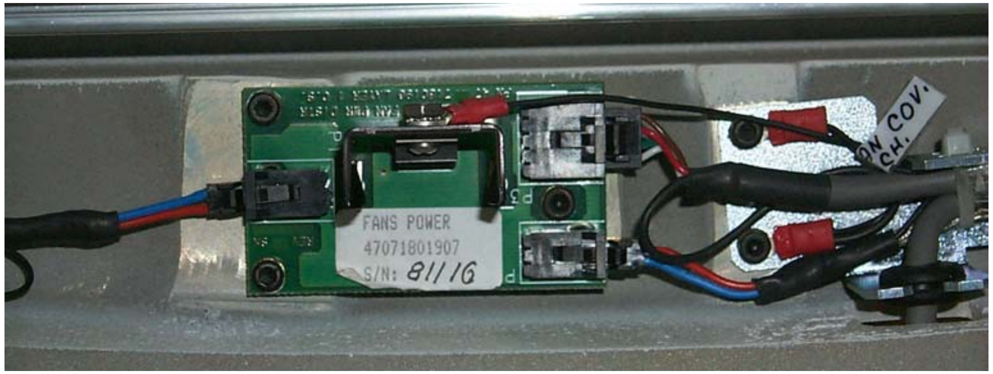


Figure 3-172: Electrical Connector for Fan Power Distribution Card

2. Open the three screws that secure the card in place.
3. Open the screw that connects the electric wire to the old card and remove the card.
4. Connect the electric wire to the new card with the screw. Pay special attention to the direction of connection shown in *Figure 3-172*.
5. Put the new card in its place on the three spacers, and secure it using the three screws, washers and safety washers with a torque of 80 Ncm.
6. Apply Loctite 222 glue to secure the screws.
7. Reconnect the three electrical connectors to the card.

Replacing the DMS Cover Fan

1. Identify the faulty fan and disconnect its connector from the Fan Power Distribution Card (see *Figure 3-172*).
2. Open all of the cable ties that hold the fan power cable to the cover.
3. Disconnect the ground wire from the cover.
4. From the outer side of the cover—open the four screws that hold the fan in place, then remove the fan.
5. Install the new fan and torque the screws to 80 Ncm.
6. Reconnect the fan power cable to the Fan Power Distribution Card
7. Secure the power cable with the cable ties, as required, and reconnect the ground wire.

Chapter 4
X-ray System

Overview 4-1

Components 4-1
Functions 4-1
Block Diagram 4-2

Functional Description 4-3

The Main Assemblies 4-3
Gantry Generator Power Supply (E606) 4-4
The Electronic Box (E603) 4-7
  Power Supply and Filtering 4-7
  The Main Inverters 4-7
  Resonance Circuit 4-10
  Inverter Output 4-10
  Ignition Circuit 4-10
  Inverter Monitoring (Inverters 1 and 2) 4-11
  Inverter Monitoring (Inverter 1 only) 4-11
  Signals in the Electronic Box 4-11
Main Control Board (D400) 4-14
  Triggering the Inverters 4-15
  Enabling and Starting the Inverters 4-15
  Main Control Board Signals 4-16
  Inverter Monitoring 4-18
  Inverter Monitoring Signals 4-20
  High Voltage Monitoring 4-23
High Voltage Tank (E604) 4-27
  Overview 4-27
  High Voltage Output Signals 4-27
Filament Power Board (D470) 4-30
  Functionality 4-30

Filament Power Board Signals 4-31
Rotating Anode Control Board (D115) 4-35
Anode Drive 4-35
Rotating Anode Control (RAC) Board Signals 4-35

Diagnostics and Troubleshooting 4-38

Introduction 4-38
Safety 4-38
X-ray System FRUs 4-39
X-ray System Block Diagram 4-39
Can Control System 4-40
Troubleshooting Flow Chart 4-41
Flowchart 1 4-42
Flowchart 2 4-43
General Diagnostic Tools and Procedures 4-47
Frequency Adaptation Calibration 4-48
Introduction 4-48
Procedure 4-49
Dummy Plugs Test 4-52
XRS Anode Starter Resistance Measurement 4-55
X-ray Tube Filaments Resistance Measurements 4-58
Single Pulse Test 4-60

Parts Replacement 4-66

Replacing the X-Ray Tube 4-66
- Tube Cooling Membrane Inspection 4-66
- X-ray Tube Replacement 4-67
- Final Steps 4-81

Replacing the E603 Electronic Box (E-Box) 4-82
- Tools and Auxiliary Materials Required 4-83
- Preparations 4-83
- Removing the Old E-Box 4-85
- Installing the New E-Box 4-92
- Final Steps 4-94
- Tests and Adjustments 4-94

Replacing the High Voltage (HV) Tank (E604) 4-95
- Tools and Auxiliary Materials Required 4-95
- Preparations 4-96
- Removing the Old Tank 4-98
- Installing the New Tank 4-101
- Final Steps 4-101
- Tests and Adjustments 4-102

Replacing the Main Control Board (D400) 4-103
- Tools and Auxiliary Materials Required 4-103
- Preparations 4-104
- Removing the Old Main Control Board 4-105
- Installing the New Main Control Board 4-107
- Final Steps 4-107
- Tests and Adjustments 4-107

Replacing the Fil (D470)/RAC (D115) Assembly 4-108
- Tools and Auxiliary Materials Required 4-108
- Estimated Time 4-109
- Preparations 4-109
- Removing the Old FIL/RAC Assembly 4-110
- Fil/RAC Installation 4-115
- Final Steps 4-115

Replacing the X-Ray Tube Heat Exchanger 4-116
- Overview 4-116
- Procedure 4-117
- Removing the Aluminum Frame 4-122
- Installation of the New Assembly 4-124
- System Check After Installation 4-126

Replacing the Electronic Box Fan 4-127
- Tools and Auxiliary Materials Required 4-127
- Preparations 4-127
- Removing the Old Fan 4-128
- Installing the New Fan 4-129
- Final Steps 4-129
- Tests and Adjustments 4-129

Replacing Fuses F4 and F5 in the Electronic Box 4-130
- Tools and Auxiliary Materials Required 4-130
- Preparations 4-130
- Changing the Fuses 4-131

Final Steps 4-132

Tests and Adjustments 4-133

Overview

Components

The Gantry Generator consists of:

- The Generator Power Supply (E606)
- The Electronic Box (E603)
- The High Voltage Tank (E604)

Functions

The function of the Generator is to:

- Supply the high voltage for the X-ray tube **kV_neg** and **kV_pos** at one of the following levels:
  - 90 kV
  - 120 kV
  - 140 kV
- Generate and regulate the filament current, which indirectly regulates the tube current, and, thusly, the dose during exposure.
- Accelerate, decelerate and monitor the anode of the X-ray tube.

Block Diagram

Figure 4-173 shows a block diagram of the X-ray system (Gantry generator).

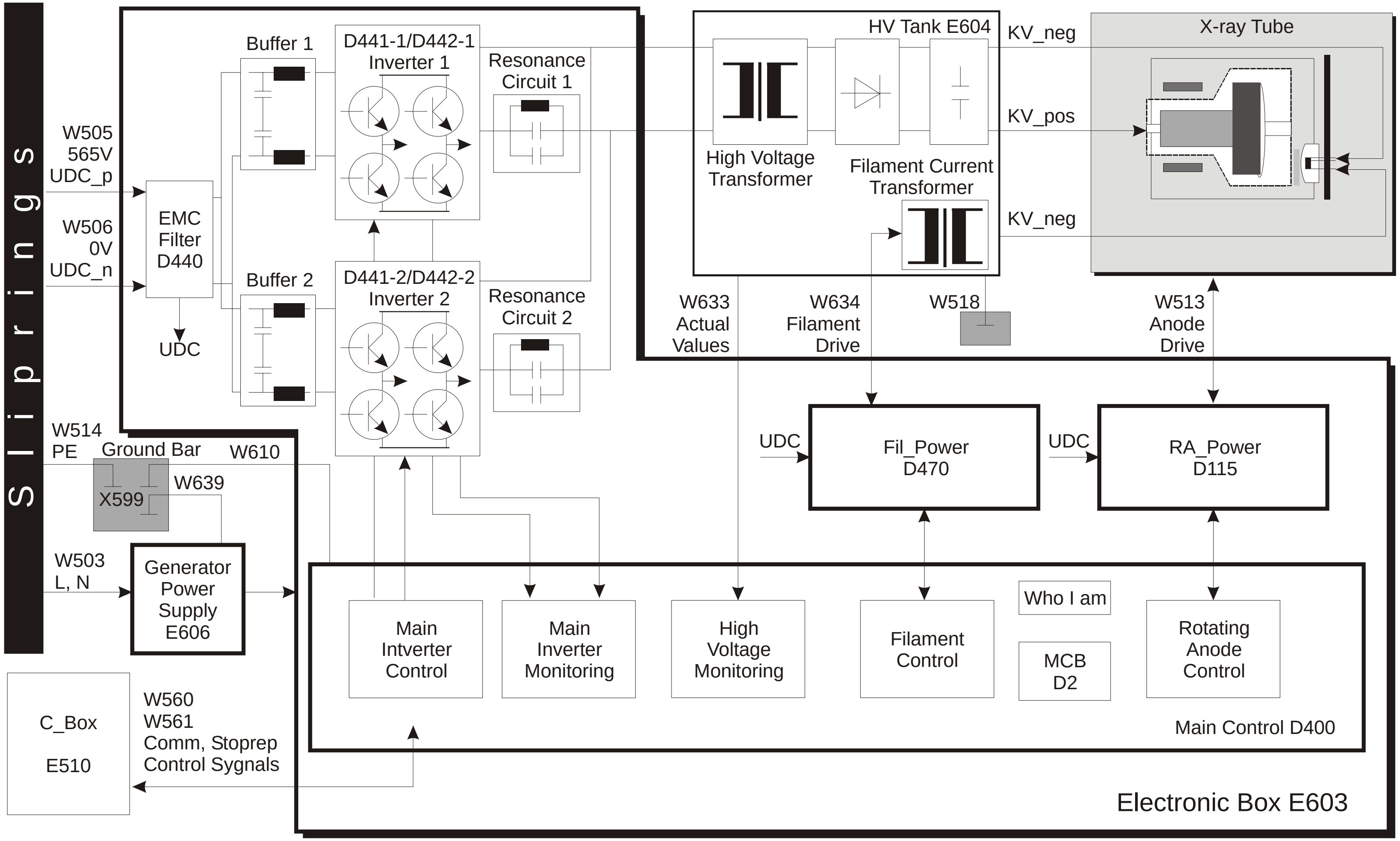

Slip rings
W505
565V
UDC_p
W506
0V
UDC_n
EMC Filter D440
UDC
Buffer 1
Buffer 2
D441-1/D442-1 Inverter 1
D441-2/D442-2 Inverter 2
Resonance Circuit 1
Resonance Circuit 2
HV Tank E604
High Voltage Transformer
Filament Current Transformer
KV_neg
KV_pos
KV_neg
X-ray Tube
W633 Actual Values
W634 Filament Drive
W518
W513 Anode Drive
W514
PE
Ground Bar
W610
W639
X599
W503
L, N
Generator Power Supply E606
UDC
Fil_Power D470
UDC
RA_Power D115
Main Intverter Control
Main Inverter Monitoring
High Voltage Monitoring
Filament Control
Who I am
MCB D2
Rotating Anode Control
Main Control D400
C_Box
E510
W560
W561
Comm, Stoprep Control Sygnals
Electronic Box E603

Figure 4-173: Block Diagram of the X-Ray System (Gantry Generator)

Functional Description

The Main Assemblies

The X-ray system (Gantry generator) includes the following main assemblies:

- **Generator Power Supply (E606) -** Receives L, N and PE from the Power Supply Stationary (PSS) through the slip rings. It also generates the following voltages and distributes them to the generator components:
  - +15 V
  - -15 V
  - +5 V
- **Electronic Box (E603) -** The electronic box contains the following:
  - EMC filter D440 shields the slip rings from the high frequency noise produced in the main inverters.
  - Buffers 1 and 2 serve as energy buffers for the high voltage.
  - Main Inverters (1 and 2) convert the 560 VDC input signals **UDC_p** and **UDC_n** from Direct Current Circuit (DCC) to a frequency regulated AC voltage (f> 20kHz) that is connected to the high voltage transformer.
  - Resonance Circuits 1 and 2, each consisting of two capacitors and one inductor, in parallel, build the oscillating circuit for the two main inverters.
  - FIL Control board D470 generates the tube filament current.
  - RA Control board D115 drives the rotating anode.
  - Main Control Board is the main controller of the whole generator.
- **Main Control Board (D400) -** The main control board does the following:
  - Controls and monitors the main inverters, the tube filament and the rotating anode.
  - Monitors the actual values of high voltage and tube current. There is an identity plug (Who I am) on the D400 which determines which generator is being used (different power stages) and which corresponding firmware is to be used.

- **High Voltage Tank (604) -** the high voltage tank contains the following:
  - The high voltage transformer transforms the AC input from the two parallel connected main inverters to the secondary side, where it is rectified and used to charge the output capacitors, thus providing **kV_pos** and **kV_neg**.
  - The filament transformer
  - Divider circuits for the measurement of the actual high voltage and the actual tube current.
- **Filament Control Board (D470) -** generates AC current for the tube filament.
- **Rotating Anode Circuit (D115) -** controls the speed of the X-ray tube.

Gantry Generator Power Supply (E606)

The Generator is supplied with the following:

- **UDC_p** and **UDC_n** (560 VDC) signals generated in the Direct Current Circuit (DCC) of the Power Distribution System (PDS) and connected through the Power Supply Stationary (PSS) to the slip rings.

  This UDC voltage is used to supply the following:
  - Main inverters 1 and 2
  - Inverter on the D115 **RA_Power** board protected by F4 and F5
  - Inverter on the D470 **FIL_Power** board protected by F4 and F5
- Line voltage L, protected by F3, to drive the internal fans M1-M4
- Line voltage L, protected by F1, to drive the E606 low voltage power supply
- Low voltages (+5 V, +15 V, -15 V) generated from E606
- Neutral N
- Protective Earth (PE), which is connected to the ground bar of the Gantry generator, and from there to the electronic box E603, the high voltage tank E604 and the X-ray tube.

Table 4-38 describes the voltages produced by the low voltage power supply E606 of the Gantry generator.

Table 4-38: Voltages Produced by the Low Voltage Supply from the Gantry Generator

VOLTAGE	FUNCTION
+5 V	Supplies the D400 Main Control Board through the F3 on-board fuse.
+15 V/(8 A)	Supplies the D400 Main Control Board through the F1 on-board fuse.
-15 V/(8 A)	Supplies the D400 Main Control Board through the F2 on-board fuse.
+15 V/(12 A)	Supplies a DC/AC converter on main inverters 1 and 2 through the F1 board fuse, thereby generating a 15 VAC voltage UHF1, UHF2. This AC voltage generates a floating power supply for the ignition circuits on the main inverters, on D115 and on D470. Also, a +15 V is used to drive the M5-M12 internal fans.

Figure 4-17 shows the layout of the components of the power supply for the Gantry generator.

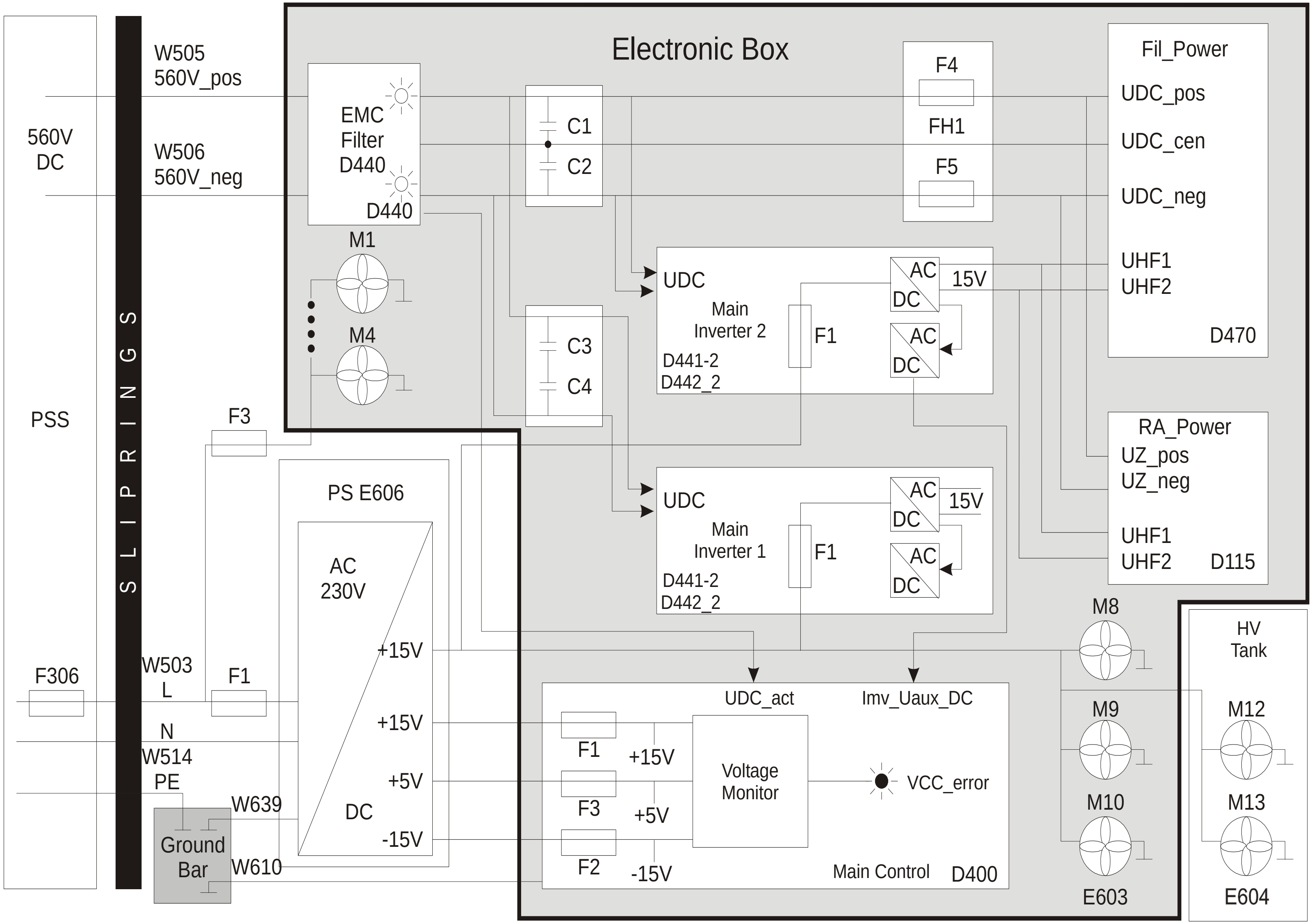

Electronic Box
560V
DC
PSS
S L I P R I N G S
W505
560V_pos
W506
560V_neg
EMC
Filter
D440
D440
M1
M4
C1
C2
C3
C4
F4
FH1
F5
Fil_Power
UDC_pos
UDC_cen
UDC_neg
UHF1
UHF2
D470
UDC
Main
Inverter 2
D441-2
D442_2
F1
AC
DC
AC
DC
15V
UDC
Main
Inverter 1
D441-2
D442_2
F1
AC
DC
AC
DC
15V
RA_Power
UZ_pos
UZ_neg
UHF1
UHF2
D115
F3
PS E606
AC
230V
+15V
+15V
+5V
-15V
DC
F306
W503
L
F1
N
W514
PE
W639
Ground
Bar
W610
UDC_act
Imv_Uaux_DC
F1
+15V
F3
+5V
F2
-15V
Voltage
Monitor
VCC_error
Main Control
D400
M8
M9
M10
E603
HV
Tank
M12
M13
E604

Figure 4-174: Gantry Generator Power Supply

The power connections for the power supply to the Gantry generator are as follows:

- **UDC_p**, **UDC_n**, **UDC_cen -** 560 VDC supply from the Direct Current Circuit (DCC) of the Power Distribution System (PDS) and connected through the Power Supply Stationary (PSS) to the slip rings.
- **UDC_pos**, **UDC_neg -** 560 VDC protected by F4 and F5 for the filament board.
- **Uz_pos**, **Uz_neg -** 560 VDC protected by F4 and F5 for the rotating anode board.
- **UHF1**, **UHF2 -** 15 VAC used to be transformed and rectified to generate a power supply for the ignition stages on the FIL_Power board and on the RA_Power board.

The Electronic Box (E603)

Inverters 1 and 2 supply AC voltage (f>20 kHz) connected as COM1 and COM2, respectively, to the high voltage transformer in the high voltage tank.

Figure 4-18 shows a block diagram of the electronic box, including the main inverters (1 and 2). See *Figure 4-176* for the signal connections in the electronic box.

Power Supply and Filtering

The UDC voltage of 560 VDC, from the slip rings, passes through the D440 EMC filter, and is buffered in two capacitor assemblies that are connected in parallel. The EMC filter prevents high frequency noise generated in the main inverters, from reaching the slip rings.

There are two yellow LEDs on D440 that indicate whether or not the capacitors are charged. They light up if the UDC voltage across the capacitors exceeds 50 V. The UDC voltage is monitored from the main control board D400 by the **UDC_act** signal, which is generated from a voltage divider on D440 out of UDC.

The Main Inverters

The buffered UDC voltage is input voltage for two main inverter circuits that work in parallel. Each main inverter assembly issues gate control pulses from the D441 ignition board to the actual Integrated Gate Bipolar Transistor (IGBT) inverter circuit (V1-V4), which is on D442, and to the corresponding resonance circuit.

The main inverters convert the DC input voltage of the **UDC_p** and **UDC_n** signals into AC voltage (COM1 or COM2) with a frequency above 20 kHz to supply the high voltage transformer in the high voltage tank.

This DC/AC conversion is performed by the IGBT bridges which, in turn, are driven by the ignition circuit.

The ignition circuit itself is triggered from the D400 Main Control board. The trigger frequency, controlled from D400, finally determines the high voltage level. The higher the trigger frequency, the higher the high voltage level, and vice versa.

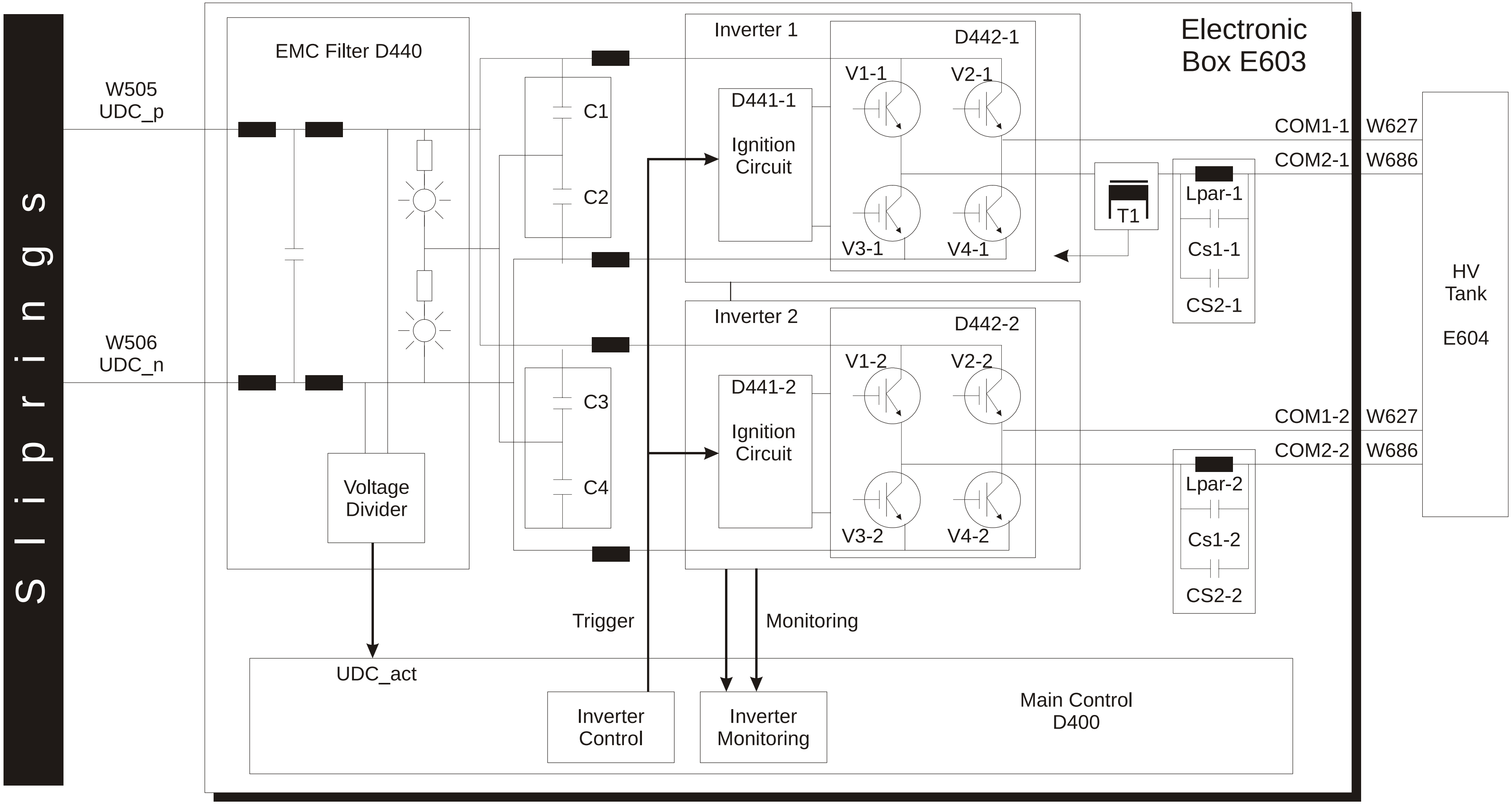

Sliprings
W505
UDC_p
W506
UDC_n
EMC Filter D440
Voltage Divider
UDC_act
C1
C2
C3
C4
Inverter 1
D442-1
D441-1
Ignition Circuit
V1-1
V2-1
V3-1
V4-1
Inverter 2
D442-2
D441-2
Ignition Circuit
V1-2
V2-2
V3-2
V4-2
Electronic Box E603
T1
Lpar-1
Cs1-1
CS2-1
Lpar-2
Cs1-2
CS2-2
COM1-1
W627
COM2-1
W686
COM1-2
W627
COM2-2
W686
HV Tank
E604
Trigger
Monitoring
Inverter Control
Inverter Monitoring
Main Control D400

Figure 4-175: Block Diagram of the Electronic Box (E603)

Resonance Circuit

Each complete inverter circuit is a combination of a serial and a parallel resonance circuit. Each resonance circuit is built from two capacitors and an inductor, all connected in parallel. The trigger frequency generated from the D400 main control board is adjusted to the resonance frequencies of that resonance circuit during tune-up. Whenever the trigger frequency from D400 changes, this adjustment is repeated.

Inverter Output

The output voltage of the two main inverters is connected in parallel and serves as input voltage for the primary side of the high voltage transformer in the high voltage tank.

The output voltages of inverter 1 are COM1-1 and COM2-1, and of inverter 2 are COM1-2 and COM2-2. These are connected to the E604 high voltage tank. Here they are joined and supply the primary side of the high voltage transformer.

Transforming the primary input voltage to the secondary side, rectifying this voltage, and charging up the output capacitors in the high voltage transformer produce the final output voltages **kV_pos** and **kV_neg** that are connected to the X-ray tube.

Ignition Circuit

The trigger-frequency of the main inverter is regulated from the D400 main control board as follows:

A. The ignition circuit is triggered from D400 with the **IGN_S1_S4** and **IGN_S2_S3** signals in an alternating sequence.
B. The ignition circuit generates the gate control pulses for the Integrated Bipolar Transistors (IGBT) bridges in an alternating sequence, thus driving the inverter.

The power supply for the gate control pulses of the ignition circuit must be floating, because the IGBTs are on a 560 V level. Therefore, the +15 V from E606 are DC/AC converted (15 Vaux), transformed and corrected in the ignition circuit to generate the floating power supply.

An additional 15 Vaux are connected as UHF1 and UHF2 from D441-1 to the **RA_Power** board D115, and from D441-2 to the D470 **FIL_Power** board. These are used after transformation and correction, as a floating power supply for the ignition circuits.

Inverter Monitoring (Inverters 1 and 2)

Imaxinv1 and **Imaxinv2** are generated from the IGBT current monitors if the IGBT current is too high.

UBmaxinv1 and **UBmaxinv2** are set from the IGBT voltage monitors if the voltage across the transistors of the main inverter is too high.

I_load_inv1 is the actual inverter current, used to check for excess current on D400.

Temp1 and **Temp2** are the temperatures of the inverters, used to check for inverter temperatures that are too high on D400.

Temp_L1 and **Temp_L2** are the temperatures of the inductors in the resonance circuits of the inverters, used to check for over-heating on D400.

Inv_Uaux_DC is the actual value of the 15 VAC, monitored on D400 for minimum value.

Inverter Monitoring (Inverter 1 only)

Transformer T1 is used to monitor the oscillating current in the resonance circuit of inverter 1. There are also several monitoring values connected from D441 and D442 to the D400 main control board.

Signals in the Electronic Box

UDC_act

For monitoring purposes, the actual UDC voltage is connected through a voltage divider to the main control board D400.

COM1-1, COM2-1, COM1-2, COM2-2

These output signals from the main inverters containing the oscillating current serve as input signals for the primary side of the high voltage transformer. The output signals of both inverters are connected in parallel to the high voltage tank.

Imaxin1, Imaxinv2

An IGBT current monitor on the D441 generates **Imaxinv1** or **Imaxinv2** if the maximum value, through an inverter bridge, is exceeded. This can cause a fatal error, which stops high voltage.

Ubmaxinv1, Ubmaxinv2

At each main inverter, the voltage across the two IGBT bridges is monitored for excess voltage. If the voltage exceeds a software-controlled maximum, **Ubmaxinv1** or **Ubmaxinv2**, and a fatal error are issued, and the scan is interrupted.

Temp1, Temp2

A temperature sensor in each main inverter reports the temperature of the inverter to the D400 using **Temp1** or **Temp2**. If the software-controlled maximum temperature is exceeded, the inverter stops for as long as the temperature remains above the maximum.

Temp_L1, Temp_L2

A temperature sensor measures the temperature of the parallel inductor in each resonance circuit and informs the D400 using the **Temp_L1** and **Temp_L2** signals. If the maximum temperature is exceeded, the main inverter is blocked for as long as the temperature remains above the maximum.

Inv_Uaux_DC

After AC/DC conversion, 15 Vaux are sent back to D400 for the purpose of monitoring. If the voltage drops below minimum, the scan is aborted with a fatal error.

I_load_inv

The actual output current of the Main Inverter is measured by means of a current transformer. If the actual current exceeds a software-controlled maximum, a fatal error issued and the scan is interrupted.

Ign_S1S4, Ign_S2S3

Trigger pulses for the ignition circuits of the main inverters, are generated and controlled from D400 with a phase shift of 180 degrees.

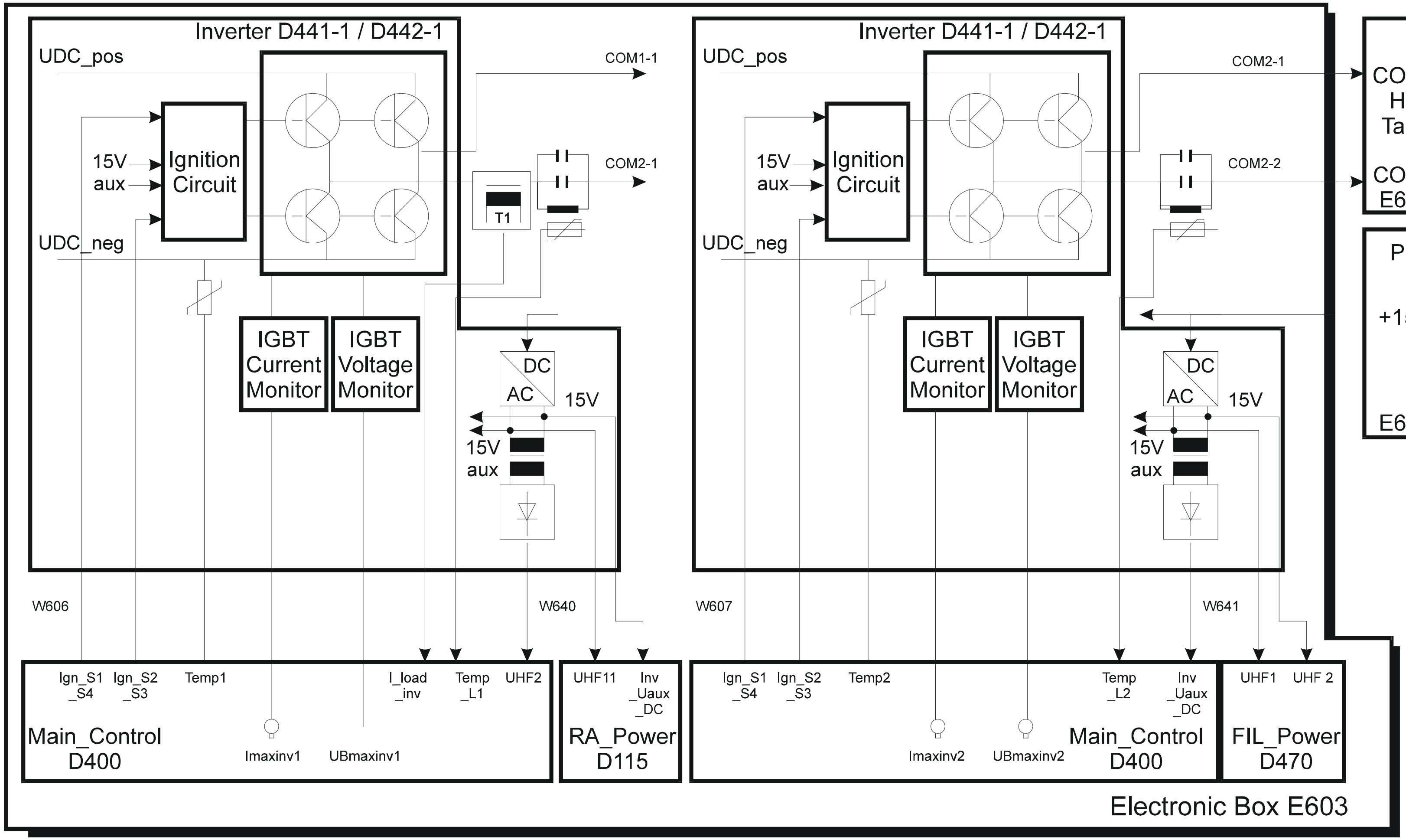

Inverter D441-1 / D442-1
UDC_pos
COM1-1
15V
aux
Ignition Circuit
COM2-1
T1
UDC_neg
IGBT Current Monitor
IGBT Voltage Monitor
DC
AC
15V
15V aux
W606
W640
Ign_S1 _S4
Ign_S2 _S3
Temp1
I_load _inv
Temp _L1
UHF2
UHF11
Inv _Uaux _DC
Main_Control D400
Imaxinv1
UBmaxinv1
RA_Power D115
Inverter D441-1 / D442-1
UDC_pos
COM2-1
15V
aux
Ignition Circuit
COM2-2
UDC_neg
IGBT Current Monitor
IGBT Voltage Monitor
DC
AC
15V
15V aux
W607
W641
Ign_S1 _S4
Ign_S2 _S3
Temp2
Temp _L2
Inv _Uaux _DC
UHF1
UHF 2
Imaxinv2
UBmaxinv2
Main_Control D400
FIL_Power D470
COM1 HV Tank
COM2 E604
PS
+15V
E606
Electronic Box E603

Figure 4-176: Signal Connections in the Electronic Box

Main Control Board (D400)

Figure 4-20 shows a block diagram of the main control board D400 in the Gantry generator.

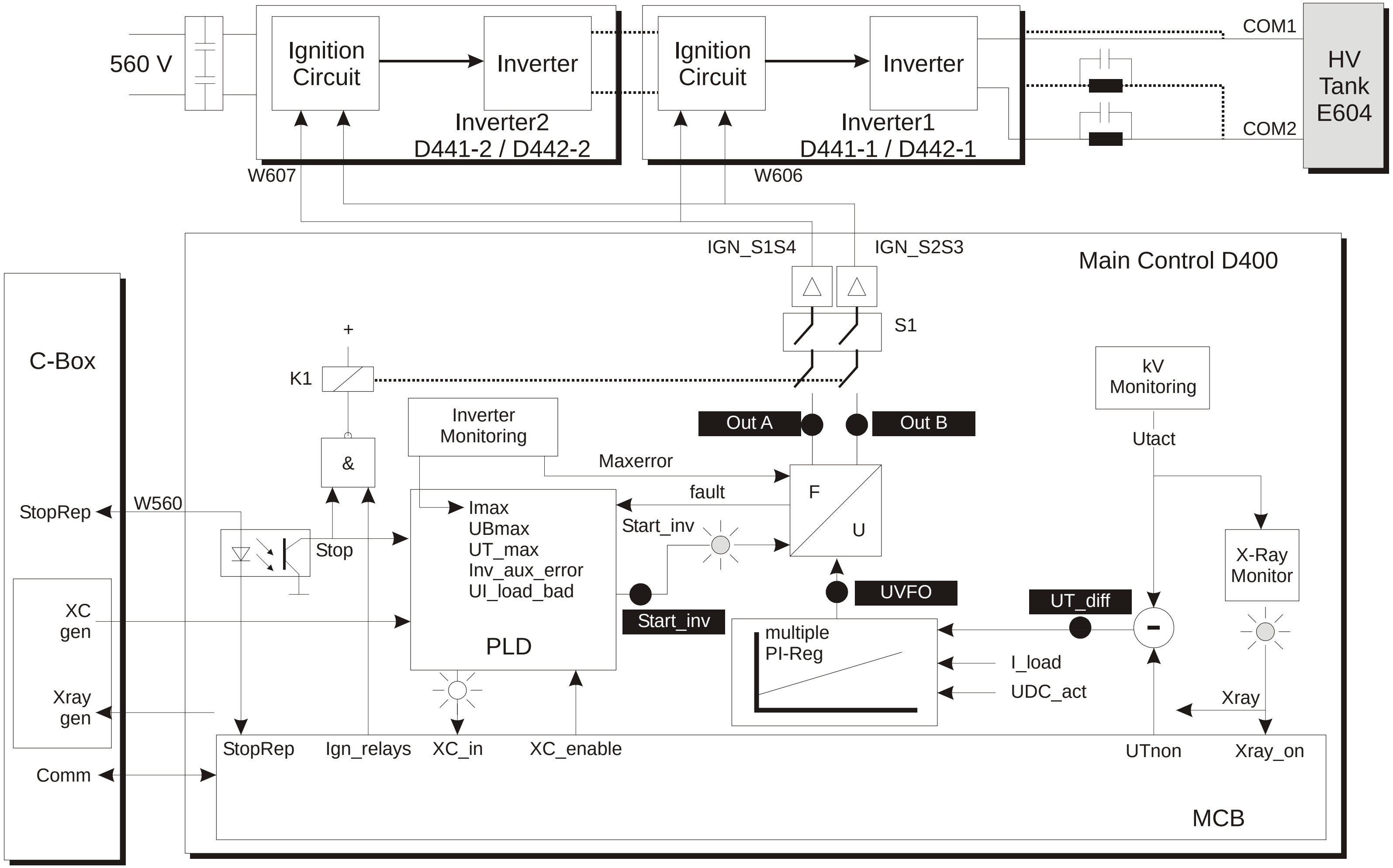

560 V
Ignition Circuit
Inverter
Inverter2
D441-2 / D442-2
W607
Ignition Circuit
Inverter
Inverter1
D441-1 / D442-1
W606
COM1
COM2
HV Tank E604
IGN_S1S4
IGN_S2S3
Main Control D400
S1
+
K1
C-Box
kV Monitoring
Inverter Monitoring
&
Out A
Out B
Maxerror
Utact
fault
F
U
StopRep
W560
Imax
UBmax
UT_max
Inv_aux_error
UI_load_bad
Stop
Start_inv
X-Ray Monitor
XC gen
Start_inv
UVFO
UT_diff
PLD
multiple PI-Reg
I_load
UDC_act
Xray gen
Xray
StopRep
Ign_relays
XC_in
XC_enable
UTnon
Xray_on
Comm
MCB

Figure 4-177: Main Control Board in the Gantry Generator

Triggering the Inverters

The main inverters and the high voltage tank, are controlled from the D400 main control board by pulses of the **Ign_S1_S4** and **Ign_S2_S3** signals. The frequency of these pulses determines the frequency of the output current from the main inverter, and, hence, the value of the high voltage.

To maintain the high voltage at the desired value, **Utnom** (see *Figure 4-177*) is sent through the CAN bus to the MCB of the D400. When a mode is loaded, a multiple PI-regulator is used. Input signals for that PI-regulator are the difference between nominal high voltage value (**Utnom**) and actual high voltage value (**Utact**), actual UDC value (**UDC_act**) and main inverter output current (**I_load**).

From these input signals, the PI-regulator generates a voltage UVFO that a U/F converter converts into the trigger frequency. The two bridges of the main inverter must be fired alternately with a phase shift of 180 degrees. Therefore, the U/F converter generates two trigger output signals alternately, **OutA** and **OutB**, resulting in **Ign_S1_S4**, **Ign_S2_S3**, both connected in parallel to main inverter 1 and main inverter 2.

Enabling and Starting the Inverters

The D400 MCB must connect the trigger signals, **OutA** and **OutB**, to their driver stages by energizing K1 with the **IGN_relay** signal.

The external input signal, XC (generated on the MCU D301), is used to start the main inverters and, thereby, the high voltage. The XC is connected to the Programmable Logical Device (PLD) on D400, generating **XC_in** to be sent to the MCB of the D400. **XC_in** results in **XC_enable** for the PLD, and, there in, **Start_inv**, which starts the U/F conversion and hence the high voltage.

This high voltage can be interrupted or blocked if any of the following occurs:

- The MCB detects any problem (i.e. temperature problems) and blocks **XC_enable.**
- The stop report loop is interrupted in any of the following ways:
  - — The Stop signal is generated
  - — The Stop signal first reaches the PLD (that blocks **Start_inv**)
  - — The Stop signal drops K1

  - The triggers for the Main Inverter are thusly disconnected
- The inverter monitoring circuits detect an error and inform the PLD, which blocks **Start_inv**. The following errors cause this:
  - **I_max**
  - **UB_max**
  - **UT_max**
  - **Inv_aux_error**
  - **UI_load_bad**
- The U/F detects an internal problem and sends a fault to the PLD which blocks **Start_inv**.
- The U/F converter is stopped when a **Maxerror** signal (see *“Inverter Monitoring”*) appears.
- The service switch S1 is active.

Main Control Board Signals

The S1 service switch can disable X-rays. There is no feedback to the firmware about the status of S1. Starting a scan with S1 opened results in an error message. See *Figure 4-177* for a block diagram that shows the signals used by the main control board.

Utnom

The nominal value of the high voltage for the next scan. It is sent to the MCB of the D400, through the CAN bus, when a mode is loaded.

Ign_S1S4, Ign_S2S3

Trigger pulses for the ignition circuit of the main inverters, which are regulated from a multiple PI-regulator.

Utact

Actual value of the produced high voltage, derived from a resistor network located in the high voltage tank and processed on D400.

I_load

Actual value of the output current from main inverter 1, derived from a current transformer at the output of main inverter 1 (COM2-1) and processed on D400.

UDC_act

Actual value of the UDC voltage is derived from a voltage divider in the D440 EMC filter and processed on D400.

UVFO

An analog voltage corresponding to the trigger frequency of the main inverter, generated from a multiple PI-regulator processing the difference between **Utnom** and **Utact**, **I_load** and **UDC_act**.

OutA, OutB

Alternately generated trigger pulses for the two bridges of the main inverters.

Start_inv

Actual start signal for the high voltage, which enables the U/F regulator to generate trigger pulses for the main inverter.

XC_in

This start-signal for the high voltage XC is converted from the PLD into **XC_in**, to be sent to the MCB, which responds with **XC_enable** back to the PLD, if the MCB detects no problems.

Ign_relays

Energizes K1 and thus connects the U/F converter output to the main inverters.

Stop

Immediately blocks high voltage, if the Stop report loop is interrupted, by blocking **Start_inv,** and disconnects the trigger pulses to the main inverter by dropping K1.

XC_enable

Software controlled start signal for the high voltage generating **Start_inv** in the PLD. Only set if the MCB detects no problems.

Xray

Generated if the high voltage value exceeds 20 kV. It is used for the following:

- To drive the X-ray lamp in the Scan Control Unit and the X-ray warning lamps.
- To inform the master D301 about the presence of X-rays.

X-ray_on

Informs the MCB that the high voltage exceeds 20 kV and, hence, there is a certain dose output.

Fault

An internal error of the U/F converter, sent to the PLD to block **Start_inv**.

Inverter Monitoring

The function of the Programmable Logical Device (PLD) or the D400 is to receive all monitor information about voltages, currents and temperatures of the main inverters. See *Figure 4-178* for a block diagram that shows the signals used for inverter monitoring.

Voltage Monitoring

The voltage across the IGBTs is monitored. If the voltage exceeds a software-controlled maximum, **Ubmaxinv1** or **Ubmaxinv2** is sent to the PLD and triggering is blocked briefly and then resumed. If this occurs more often than the maximum number of excessive voltages per scan, the scan is aborted.

Current Monitoring

The current running through the IGBT bridges is monitored. If the current exceeds a software-controlled maximum, **Imaxinv1** or **Imaxinv2** is sent to the PLD and triggering is blocked by the PLD logic (see *“Triggering the Inverters”*).

The firmware decides whether and how often a restart of the main inverter is tried within the scan. If the maximum number of errors per scan is exceeded, a fatal error is recognized and the scan is interrupted.

Any error **Ubmaxinv1**, **Ubmaxinv2**, **Imaxinv1** or **Imaginv2** results in **Maxerror**. For increased safety, in addition to removing **Start_Inv** (by the PLD receiving either **Imax** or **Ubmax**), **Maxerror** disables the U/F converter for the generation of main inverter trigger pulses (see *“Triggering the Inverters”*).

Output Current Monitoring

The actual output current of the Main Inverter, **I_load** is measured by a current transformer and transmitted to D400. After calculation of the mean value of the output current **UI_load_act**, this signal is connected to a monitor.

The mode of the monitor is preset with **UI_load_max** from the MCB, which receives this value through the CAN whenever a mode is loaded. If the actual inverter output current exceeds the mode set by **UI_load_max**, **UI_load_bad** is generated, sent to the PLD and the inverter is blocked by the PLD logic (see *“Triggering the Inverters”*).

The firmware decides whether and how often a restart of the main inverter is tried within the scan. If the maximum number of errors per scan is exceeded, a fatal error is recognized and the scan is interrupted.

Temperature Monitoring

The following four temperatures are monitored from the MCB by temperature sensors:

- The inverter temperature connected as Tempinv1, or Tempinv2 to the MCB.
- The temperature of the parallel inductor in each resonance circuit, connected as TempLpar1, TempLpar2 to the MCB.

Each measured temperature is compared with a firmware maximum. If any temperature is too high, the MCB interrupts the scan (**XC_enable** is removed) and further scanning is blocked until that temperature is below the threshold.

Ignition Power Supply Monitoring

The 15 Vaux are adjusted and connected as **Inv_Uaux_DC** to the D400, and monitored for a minimum value. If **Inv_Uaux_DC** is lower than the specified minimum voltage, an **Inv1_aux_err** or **Inv2_aux_err** signal is sent to the PLD and the scan is interrupted.

Inverter Monitoring Signals

I_load

The actual output current from the main inverter. **I_load,** is measured by a current transformer and is transmitted to D400.

UI_load_act

Output current, **I_load**, after the calculation of the mean value. This signal is connected to the **I_load** monitor.

UI_load_bad

This fault is sent from the **I_load** monitor to the PLD if the actual inverter output current **UI_load_act** exceeds the maximum value **UI_load_max**. The inverter is blocked by the PLD logic (see *"Triggering the Inverters"*).

The firmware decides whether and how often a restart of the main inverter within the scan is tried. If the maximum number of errors per scan is exceeded, a fatal error is recognized and the scan is interrupted.

UI_load_max

Maximum value permitted for the inverter output current

Inv_Uaux_DC

The 15 Vaux are rectified and connected as **Inv_Uaux_DC** to the D400, to be monitored for a minimum value.

Inv1_aux_err, Inv2_aux_err

If **Inv_Uaux_DC** is lower than a specified minimum voltage, the **Inv1_aux_err**, or **Inv2_aux_err** signal is sent to the PLD. As a result, triggering is blocked by the PLD logic (see *“Triggering the Inverters”*).

The firmware decides whether and how often a restart of the main inverter for the scan is tried. If the maximum number of errors per scan is exceeded a fatal error is recognized and the scan is interrupted.

Tempinv1, Tempinv2

Main inverter temperature detected by a temperature sensor.

TempLparl, TempLpar2

Temperature of the inductor in the resonance circuit detected by a temperature sensor.

Inv_Fault

This LED is switched ON from the PLD if any inverter error occurs.

FLEX_Fault

This LED is switched ON from the PLD if any internal error occurs.

Temp_Error

This LED is switched ON from the PLD if any temperature error occurs.

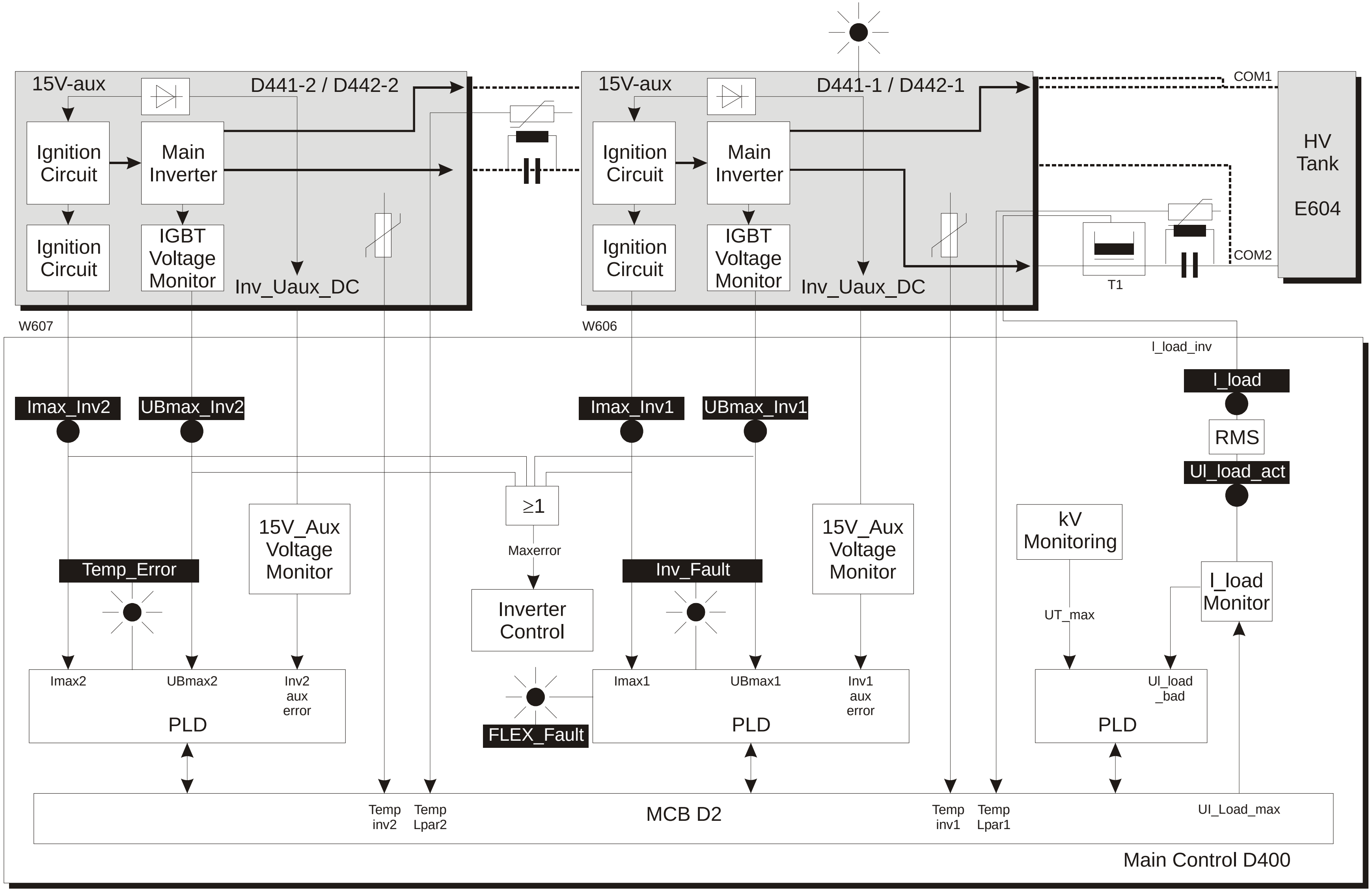

15V-aux
D441-2 / D442-2
Ignition Circuit
Main Inverter
Ignition Circuit
IGBT Voltage Monitor
Inv_Uaux_DC
15V-aux
D441-1 / D442-1
Ignition Circuit
Main Inverter
Ignition Circuit
IGBT Voltage Monitor
Inv_Uaux_DC
COM1
HV Tank
E604
COM2
T1
W607
W606
I_load_inv
I_load
RMS
UI_load_act
Imax_Inv2
UBmax_Inv2
Imax_Inv1
UBmax_Inv1
≥1
Maxerror
Inverter Control
15V_Aux Voltage Monitor
15V_Aux Voltage Monitor
kV Monitoring
UT_max
I_load Monitor
Temp_Error
Inv_Fault
FLEX_Fault
Imax2
UBmax2
Inv2 aux error
PLD
Imax1
UBmax1
Inv1 aux error
PLD
UI_load _bad
PLD
Temp inv2
Temp Lpar2
MCB D2
Temp inv1
Temp Lpar1
UI_Load_max
Main Control D400

Figure 4-178: Gantry Generator Inverter Monitoring

High Voltage Monitoring

The D400 main control board monitors the following:

- The high voltage (**UTact**, **N_UTmax**, **P_UTmax**, **OneSideArc**, **BothSidesArc** and **HV_drop**)
- The tube current (**IT_act)**
- The temperature and oil pressure in the high voltage tank using feedback values from D432 (**T_H1, Max_P_H1)**
- The output voltages of the generator power supply (**Vcc_error)**

See *Figure 4-179* for a block diagram that shows the signals used for high voltage monitoring.

UTact

The negative **N_UTact** and positive **P_Utact** high voltages, are combined to generate **UTact**, the actual value of the high voltage. This value is sent to the MCB and used for regulation of the trigger frequency of the main inverter (see *“Triggering the Inverters”*).

N_UTmax, P_UTmax

The actual negative **N_UTact** and positive **P_UTact** high voltages are monitored for maximum values. If **N_UTact** is below -82 kV or **P_UTact** is above +82 kV, the corresponding fatal error **N_UTmax** or **P_UTmax** is issued to the PLD, and the PLD logic blocks triggering (see *“Triggering the Inverters”*).

The firmware decides whether and how often a restart of the main inverter is tried in the scan. If the maximum number of errors per scan is exceeded, a fatal error is recognized and the scan is interrupted.

OneSideArc

The actual negative **N_UTact** and positive **P_UTact** high voltages are checked against a slope detector (**UTmax** monitor) for a fast drop indicating an arc. If arcing occurs on one side, the **OneSideArc** signal is sent to the PLD. This stops the main inverter immediately, for a short time. The PLD then tries to re-trigger it for the next reading.

In addition, the **HV_drop** signal is sent to the ACU D513 and the arcing reading is marked for the IRS to skip it for reconstruction. If the maximum number of arcs per scan is reached, a fatal error occurs and the scan is aborted.

BothSidesArc

The actual negative **N_UTact** and positive **P_UTact** high voltages are checked against a slope detector (UTmax monitor) for a fast drop indicating an arc. If arcing occurs on both sides at the same time, the **BothSidesArc** signal is sent to the PLD. This stops the main inverter immediately, for a short time. The PLD then tries to re-trigger it for the next reading.

In addition, the **HV_drop** signal is sent to the ACU D513 and the arcing reading is marked for the IRS to skip it for reconstruction. If the maximum number of arcs per scan is reached, a fatal error occurs and the scan is aborted.

HV_drop

HV_drop is sent to the ACU D513 and the arcing reading is marked for the IRS to skip it for reconstruction. If the maximum number of arcs per scan is reached, a fatal error shows up and the scan is aborted.

IT_act

The tube current is monitored from the MCB to measure its limits. If the tube current is too low, or too high, the main inverter is blocked from the MCB.

The firmware decides whether and how often a restart of the main inverter is tried within the scan. If the maximum number of errors per scan is exceeded, a fatal error is recognized and the scan is interrupted.

T_H1

The temperature of the oil in the high voltage transformer is measured by a temperature sensor. The **Temp_H1** signal is monitored from the MCB for over-heating. If the oil gets too hot, the scan is aborted and further scans are not permitted until the temperature drops below the required level.

Max_P_H1

If the pressure is too high, the oil pressure switch inside the high voltage tank opens and **Max_P_H1** is sent to the MCB. As a result, the scan is aborted and further scanning is not permitted.

Vcc_error

The +15 V, -15 V and 5 V voltages are monitored for tolerances. If any voltage is outside the tolerances, the **Vcc_error** signal is set and the MCB blocks the main inverter.

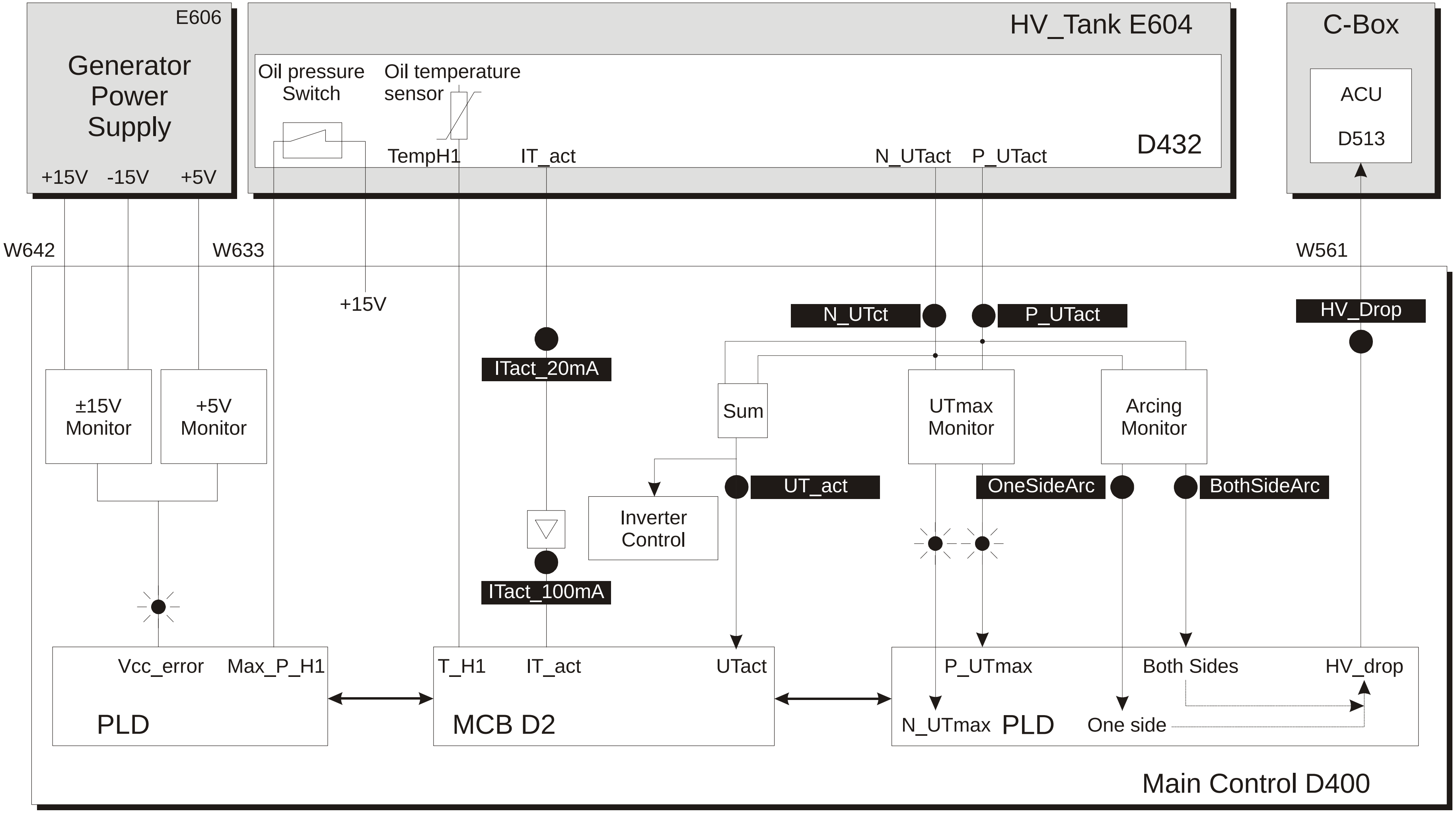

E606
Generator Power Supply
+15V
-15V
+5V
HV_Tank E604
Oil pressure Switch
Oil temperature sensor
TempH1
IT_act
N_UTact
P_UTact
D432
C-Box
ACU
D513
W642
W633
W561
+15V
N_UTct
P_UTact
HV_Drop
ITact_20mA
±15V Monitor
+5V Monitor
Sum
UTmax Monitor
Arcing Monitor
Inverter Control
UT_act
OneSideArc
BothSideArc
ITact_100mA
Vcc_error
Max_P_H1
PLD
T_H1
IT_act
UTact
MCB D2
P_UTmax
Both Sides
HV_drop
N_UTmax
PLD
One side
Main Control D400

Figure 4-179: Gantry Generator High Voltage Monitoring

High Voltage Tank (E604)

Overview

The high voltage transformer in the High Voltage (HV) tank transforms the AC input current delivered from the main inverter to the secondary side, where it is rectified and used to charge capacitors to **KV_pos** and **KV_neg** (to UT).

The isolation transformer for the AC filament current delivered from **FIL_Power** on D470 is also mounted in the HV tank. In addition, voltage dividers inside the tank generate the actual values for high voltage and tube current on D432 (mounted on top of the tank).

See *Figure 4-180* for a block diagram that shows the signals used by the high voltage tank.

High Voltage Output Signals

KV_pos, KV_neg

Positive and negative side of the high voltage to be connected to the X-ray tube.

Fil_large

AC filament current that supplies the big focal spot in the X-ray tube (upper two wires of high voltage cable W511 in *Figure 4-180*).

Fil_small

AC filament current that supplies the small focal spot in the X-ray tube (lower two wires of high voltage cable W511 in *Figure 4-180*).

P_Nact, N_Utact

The actual values from D432 of the negative (**N_Utact**) and the positive (**P_Utact**) high voltage are measured by a voltage divider. Both are connected to the main control board D400 for controlling and monitoring the high voltage.

It_act

The actual tube current from D432, **It_act**, is measured as the voltage across a resistor near to ground and connected to the D400 main control board for monitoring the tube current.

Temp_H1

Signal from the temperature sensor, mounted on the rear of D432, that monitors the temperature of the oil inside the high voltage tank. It is connected to the D400 main control board as **Temp_H1**.

Max_P_H1

As soon as the oil pressure inside the tank exceeds a given limit, the pressure switch opens. The **Max_P_H1** signal notifies the main control board D400 and the MCB aborts the scan.

mA_meas_on

In certain modes, the actual tube current can be measured directly with an A-meter by connecting the meter to X18, X19 and opening the service switch S1. The MCB is informed about the condition of the S1 switch by the signal **mA_meas_on**.

The Mx8000 scans in "normal mode" if S1 is opened ("ON") without a meter connected and S1 "ON" (OPEN), the mA feedback path is open allowing KV to be across the switch contacts during an exposure. Under these conditions, S1 is destroyed (melts) and the HV Tank must be replaced.

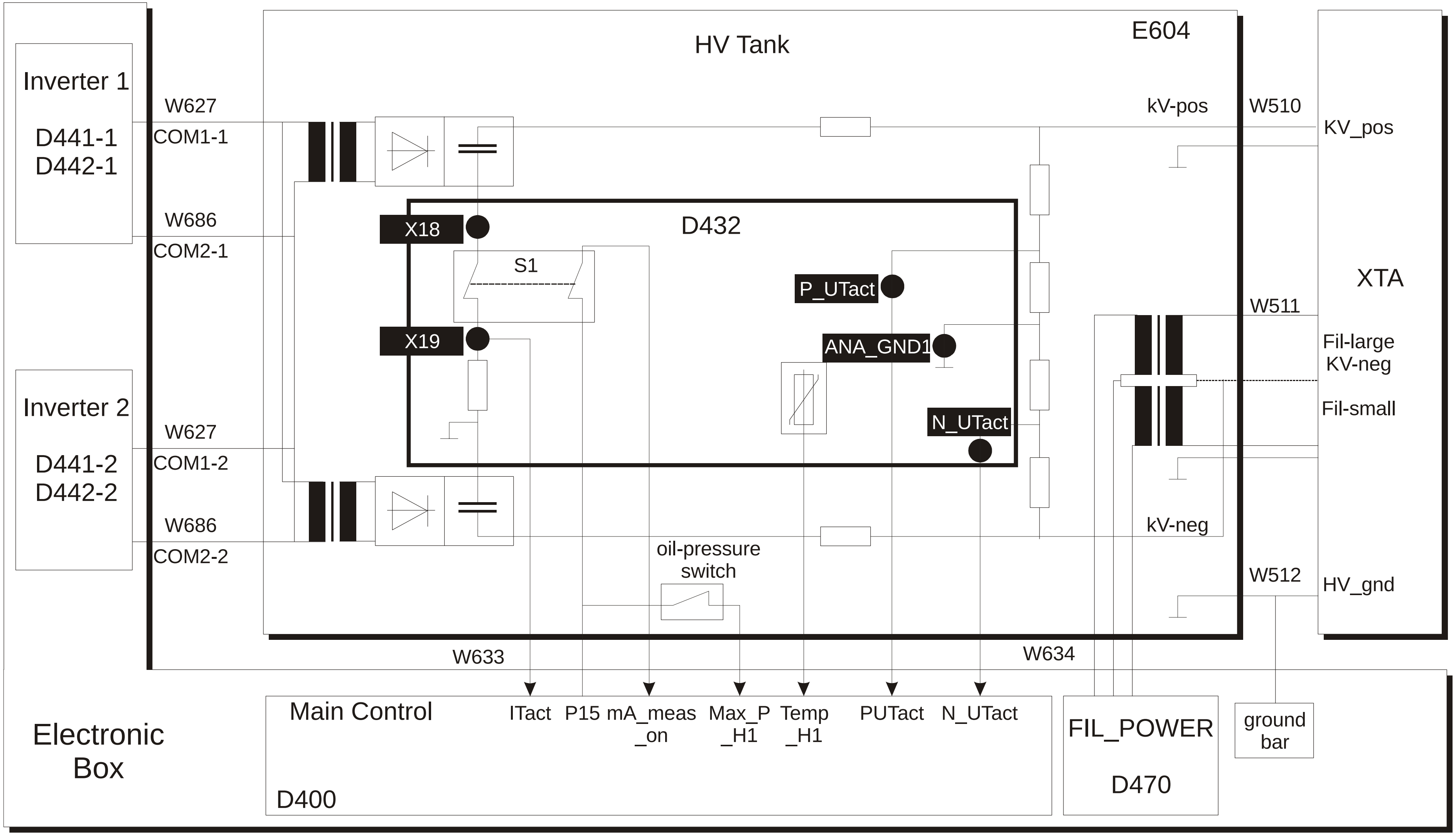

Inverter 1
D441-1
D442-1
Inverter 2
D441-2
D442-2
W627
COM1-1
W686
COM2-1
W627
COM1-2
W686
COM2-2
HV Tank
E604
D432
X18
X19
S1
P_UTact
ANA_GND1
N_UTact
oil-pressure switch
kV-pos
kV-neg
W510
W511
W512
XTA
KV_pos
Fil-large
KV-neg
Fil-small
HV_gnd
W633
W634
Electronic Box
Main Control
D400
ITact
P15
mA_meas_on
Max_P_H1
Temp_H1
PUTact
N_UTact
FIL_POWER
D470
ground bar

Figure 4-180: Gantry Generator High Voltage Tank

Filament Power Board (D470)

The D470 filament power board, **FIL_Power**, generates the AC current for the tube filament, by converting the 560 VDC **UDC_p** and **UDC_n** input signals into frequency regulated AC, connected to either the big focal spot (**Fil_large** and **Fil_rtn**) or to the small focal spot (**Fil_small** and **Fil_rtn**). This DC/AC conversion is performed from an inverter circuit, which is controlled from the MCB on the D400 main control board.

To start the filament current, the D400 MCB must trigger the ignition circuit (**Fil_out_A**, **Fil_out_B**) on D470, resulting in the gate control pulses for the filament inverter and thus a current flow. The ignition circuit requires a floating power supply, that is produced by transforming and rectifying the 15 VAC input signals **UHF_1** and **UHF_2**.

The D470 filament power board contains the ignition circuit and the actual inverter to drive the tube filament, as well as the control relay to select the small or big focal spot and the transformer to detect the actual filament current **I_load_fil**.

See *Figure 4-181* for a block diagram that shows the signals used by the filament power board.

Functionality

Filament Modes

The tube filament is driven in two different modes:

- **Filament control mode** (always active without high voltage) **-** In this mode the filament is supplied with a fixed filament current.

  In this mode, the filament takes on a base temperature, high enough to take on the exposure temperature required for scanning in a very short time (during preparation) and low enough to ensure a long filament lifetime.
- **Dose rate control mode** (active whenever high voltage is applied) **-** This mode is used during exposure, to ensure as stable a dose rate as possible.

When a mode is loaded, the nominal dose value for that mode is transmitted, with the mode table, to the MCB of D400. During the scan, the actual dose (**J_act**) is measured from the PHI-PSD in the tube collimator housing, and connected as **Fil_dose** to the MCB. The MCB adjusts the trigger frequency of the filament inverter and the filament current to keep **Fil_dose**, the dose, constant.

Filament Drive

The filament is started, from the MCB, by instructing the PLD to issue **Start_fil_inv**. This signal causes the V/F converter to alternately generate trigger pulses **Fil_out_A** and **Fil_out_B** with a frequency according to the analog voltage **Y_fil**, issued from the MCB.

After power ON of the scanner, the filament is started (after the first successful Reset in the filament control mode) according to the nominal filament current received with a fixed table. The MCB keeps that current constant by regulating **Y_fil** according to the measured actual filament current **I_f_act**.

When a scan is performed, the dose rate control mode is used, and instead of the actual filament current **I_f_act**, the actual dose **Fil_dose** is used to regulate **Y_fil**, resulting in a stable dose during exposure. The nominal dose value was received before the start of the scan from the MCB with the mode table.

The actual dose information **Fil_dose**, from the PHI-PSD, is active only during scanning. With scan-start, when **Fil_dose** builds up it, the MCB monitors this signal for reaching a certain threshold, and issues **Dose_ok** to start the DMS when this threshold is reached.

Filament Power Board Signals

Fil_large

Connected to the tube, together with **Fil_rtn**, if the large focal spot is selected.

Fil_small

Connected to the tube, together with **Fil_rtn**, if the small focal spot is selected.

Fil_rtn

Return for both filament supplies.

Fil_dose, J_act

Actual dose during scan, measured from PHI-PSD in the tube collimator housing.

Dose_ok

The actual dose information, **Fil_dose** from PHI-PSD, is active only during scanning. When a scan starts, **Fil_dose** increases the dose and the MCB monitors this signal. When it reaches a certain threshold, and the MCB issues **Dose_ok** to start the DMS.

Start_fil_inv

Start signal for the V/F converter, to generate trigger pulses for the ignition stage of the filament inverter.

Fil_out_A, Fil_out_B

Alternately generated trigger pulses for the ignition stage of the filament inverter.

Y_fil

Analog control voltage for the trigger frequency of the inverter, regulated from firmware.

I_f_act

Actual output current of the filament inverter. Used to regulate **Y_fil** in the filament control mode and for monitoring.

FIL_Inv_Fault

This LED is switched on from the PLD if any filament error occurs.

I_load_fil, I_f_act, I_f_min, I_f_max

The actual filament current, **I_load_fil**, is RMS converted, called **I_f_act**, and monitored for maximum and minimum current flow. If the current is below 2 A, **I_f_min** is generated. If the current is above 9 A, **I_f_max** is generated. Both are transmitted to the PLD, which blocks and notifies the MCB and issues a fatal error to abort the scan.

I_max_fil

The filament inverter current is monitored on D470 for maximum current through the IGBTs (Imax monitor). When the inverter current is too high, **I_max_fil** is sent to the PLD which blocks **Start_fil_inv**, informs the MCB and issues a fatal error to abort the scan.

I_f_lim, F_lim

The issued analog voltage, **Y_fil**, is monitored for a maximum voltage, corresponding to a maximum trigger frequency, and a maximum filament current. With an application table the MCB receives **I_f_lim**, the maximum value for **Y_fil**,. If **Y_fil** reaches that maximum, a diode limits any further increase of **Y_fil** and the MCB is informed with **F_lim**.

_Small_focus_rel, Check_small_foc

To switch from the big (default) focal spot to the small focal spot, the MCB sends **_Small_focus_rel** to the board D470. A relay is energized, **Fil_small** and **Fil_rtn** are selected and the feedback signal **Check_small_foc** informs the MCB about the successful switch.

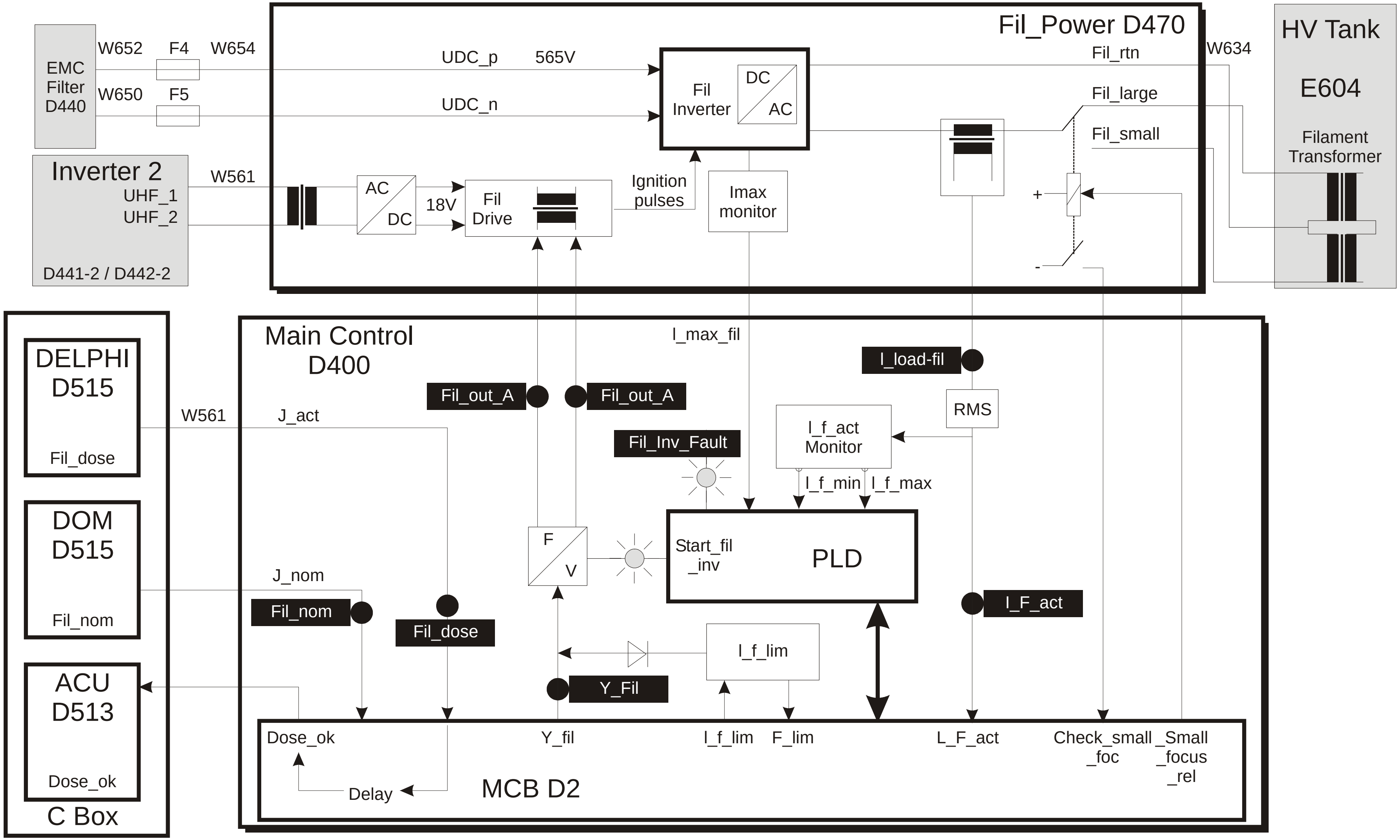

Fil_Power D470
HV Tank
E604
Filament Transformer
W634
Fil_rtn
Fil_large
Fil_small
EMC Filter D440
W652
F4
W654
W650
F5
UDC_p
565V
UDC_n
Fil Inverter
DC
AC
Inverter 2
UHF_1
UHF_2
D441-2 / D442-2
W561
AC
DC
18V
Fil Drive
Ignition pulses
Imax monitor
+
-
Main Control D400
I_max_fil
I_load-fil
RMS
Fil_out_A
Fil_out_A
Fil_Inv_Fault
I_f_act Monitor
I_f_min
I_f_max
F
V
Start_fil _inv
PLD
I_F_act
I_f_lim
Y_Fil
J_act
J_nom
Fil_nom
Fil_dose
DELPHI D515
Fil_dose
DOM D515
Fil_nom
ACU D513
Dose_ok
C Box
Dose_ok
Delay
Y_fil
I_f_lim
F_lim
L_F_act
Check_small _foc
_Small _focus _rel
MCB D2

Figure 4-181: Gantry Generator Filament Control Board

Rotating Anode Control Board (D115)

The function of the Rotating Anode Circuit (RAC) is to accelerate, maintain and decelerate the speed of the anode of the X-ray tube. This is executed by the Rotating Anode Control (RAC) D115 board (**RAC_Control**) and the Main Control Board D400. For each scan, the D400 MCB receives the nominal speed of the anode with the mode table.

See *Figure 4-182* for a block diagram that shows the signals used by the Rotating Anode Control (RAC) board.

Anode Drive

The rotating anode control (RAC) board contains a DC/AC inverter that drives the stator of the rotate anode inside the tube. This inverter consists of six IGBTs that convert the 560 VDC (**UDC_pos**, **UDC_neg**) to three-phase AC (**AN_0**-**AN_2**). It is driven by the ignition circuit, which is triggered by the main inverter control board D400 (**ANLO**-**ANL5**).

The ignition circuit from the DC/AC converter requires a floating DC power supply because the IGBTs are on a 560 V level. Therefore **UHF1**, **UHF2** (15 VAC) from main inverter 1 are transformed and rectified on the D115.

The anode is accelerated in the preparation phase (in parallel to the offset measurement), kept on speed (triggered) during the scan and slowed after the scan. For braking only one bridge of the IGBT bridge circuit is triggered, generating a DC component for the AC motor.

To measure the actual speed of the anode for the regulation of the trigger frequency, triggering is stopped for a moment, the signal **F_rot_relay**, which activates relay K200, is set and the remanence frequency (actual frequency) picked up from two phases, is sent to the PLD as **F_rot**. According to the measured actual frequency **F_rot**, the frequency of the trigger pulses **ANL0**-**ANL5** is changed.

Rotating Anode Control (RAC) Board Signals

ANL0-ANL5

The main control board D400 supplies the six trigger pulses (**ANL0**-**ANL5**) for the ignition circuit of the DC/AC inverter on the RAC control board D115. The frequency of the trigger pulses determines the speed of the rotating anode. The frequency is regulated from the firmware.

Ret1

One phase (**AN_2**) of the DC/AC inverter output current is used to check the current of the anode drive. The current is measured by a current transformer.

F_Rot_pulse

The AC current **Ret1** is converted to a square wave signal (**F_rot_pulse**). The firmware counts the pulses per time unit and calculates the frequency of the output current. If the calculated frequency does not follow the trigger frequency, the main inverter is blocked, a fatal error is issued and the scan is interrupted.

Measure_AD

From the AC current **Ret1** the mean value is calculated and connected to the MCB D2. If the current exceeds the permitted tolerance, the main inverter is blocked, a fatal error is issued and the scan is interrupted.

F_rot, F_rot_TTL

Two phases (**AN_0**; **AN_2**), connected to the anode stator, are used to measure the actual frequency while the triggering of the inverter is stopped for a short moment. If the measured actual frequency is out of tolerance, a fatal error is issued and the scan is interrupted.

F_rot_relay

F_rot_relay is set for the time the inverter triggering is stopped to activate relay K200. The K200 relay connects two phases **AN_0**, **AN_2** to the sensor circuit for the measurement of the actual frequency (remanence signal).

R_kurz, Short_rot

The IGBTs for the DC/AC are monitored in the inverter to detect overly high current. When the current is too high, the signal **Short_rot** is sent to the PLD to inform the MCB, the main inverter is blocked, a fatal error is issued and the scan is interrupted.

RAC_Inv_Fault

This LED is switched ON from the PLD if any anode inverter error occurs.

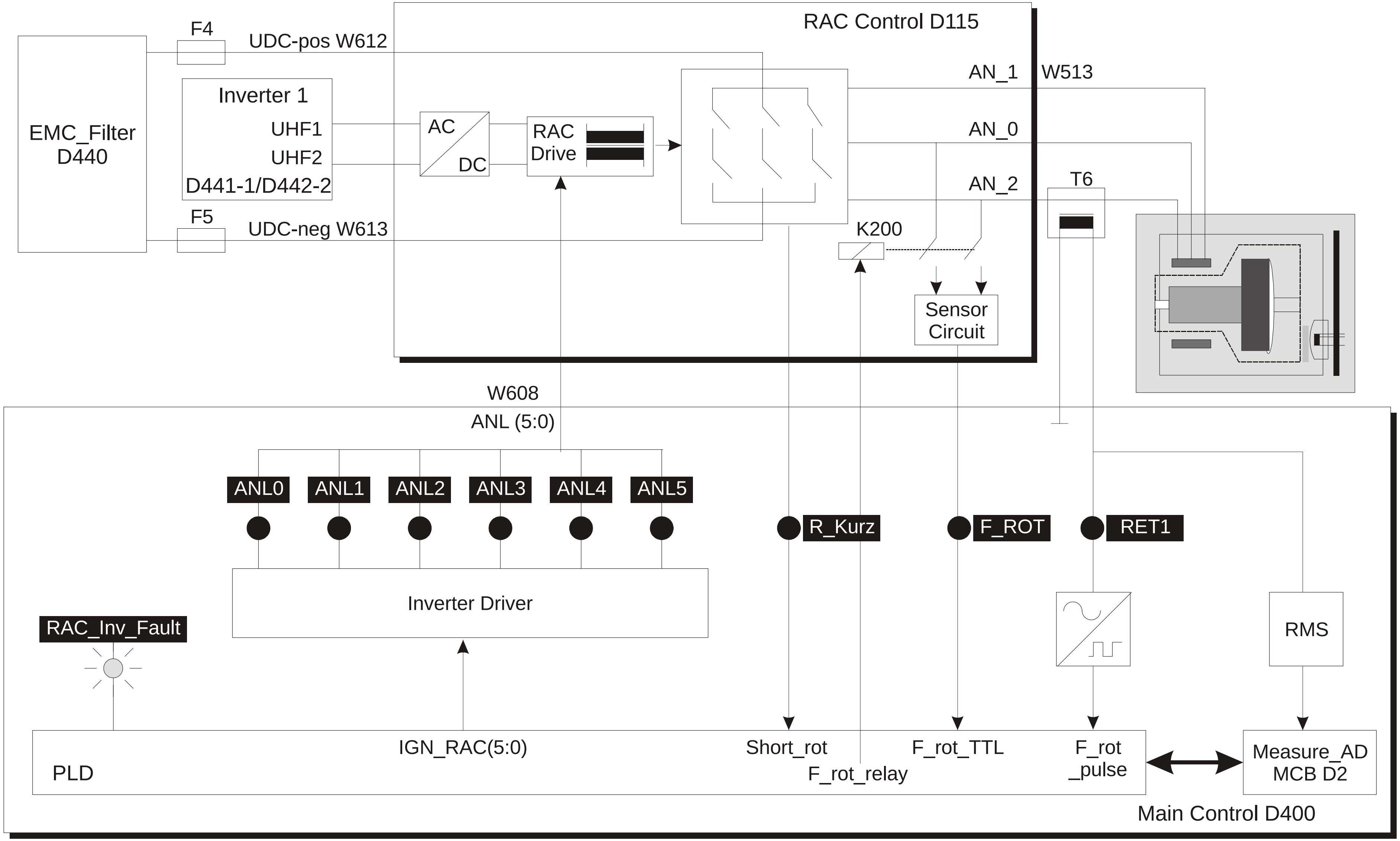

RAC Control D115
F4
UDC-pos W612
EMC_Filter
D440
Inverter 1
UHF1
UHF2
D441-1/D442-2
AC
DC
RAC
Drive
AN_1
W513
AN_0
AN_2
T6
F5
UDC-neg W613
K200
Sensor
Circuit
W608
ANL (5:0)
ANL0
ANL1
ANL2
ANL3
ANL4
ANL5
R_Kurz
F_ROT
RET1
Inverter Driver
RAC_Inv_Fault
RMS
IGN_RAC(5:0)
Short_rot
F_rot_TTL
F_rot
_pulse
F_rot_relay
PLD
Measure_AD
MCB D2
Main Control D400

Figure 4-182: Gantry Generator Anode Control Board

Diagnostics and Troubleshooting

Introduction

This document describes the principles for troubleshooting the Mx8000 x-ray system by means of a flowchart. It is intended for a trained service engineer who is familiar with the x-ray system components and with the CanPro program. For x-ray system functional descriptions, see *“Functional Description”*.

Safety

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

X-ray System FRUs

The x-ray system main FRUs are:

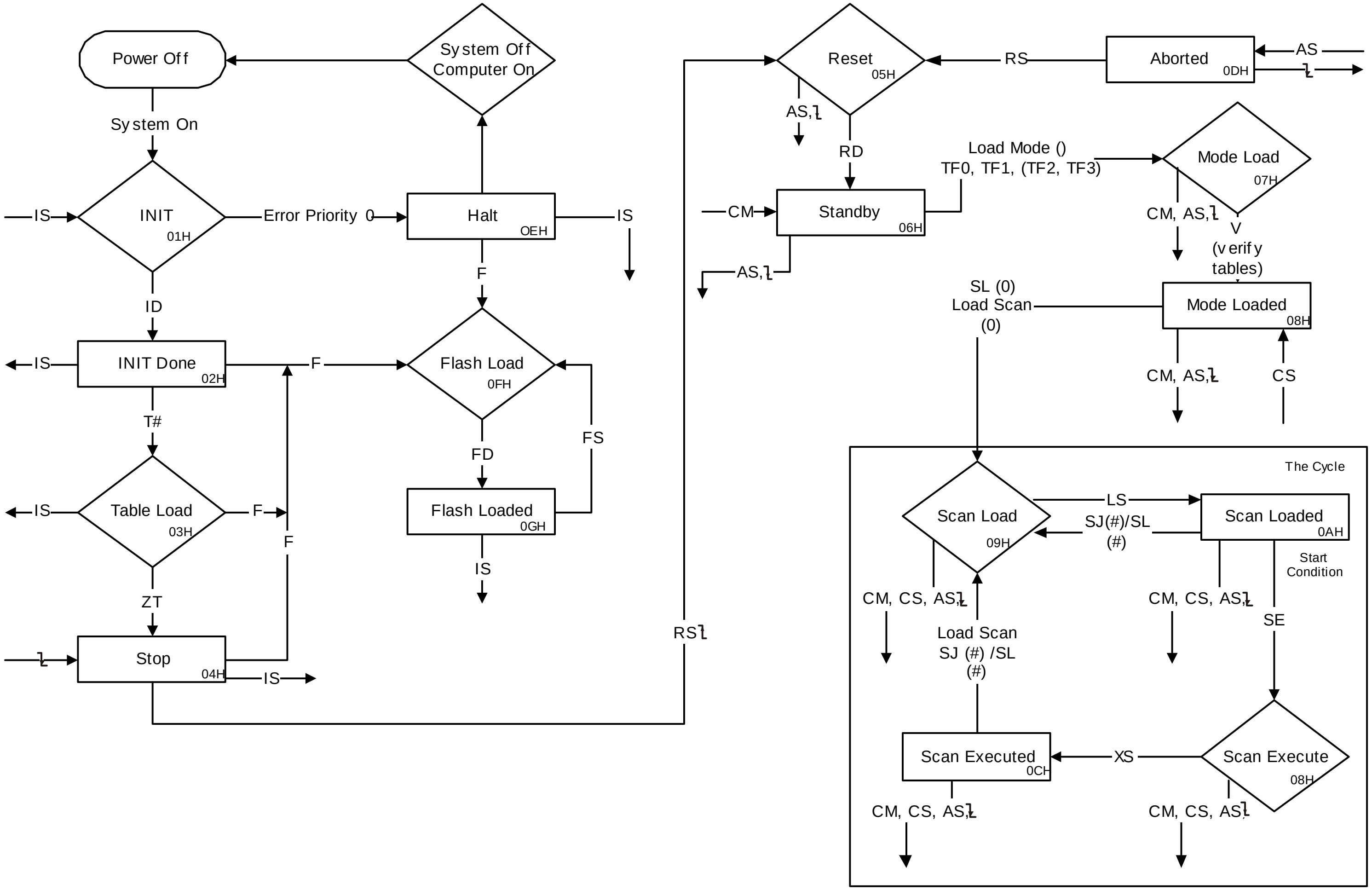
- X-ray tube
- Electronic box—E603
- Fil/RAC—D-470+D-115
- Main Control—D-400
- Generator Power Supply—E606
- High Voltage Tank—E604
- MCB
- D-451

X-ray System Block Diagram

See *Figure 4-173* for the X-ray System block diagram.

Can Control System

It is important to be familiar with the Can Control System, specifically the functional specifications. For more detailed information, see . The following *Figure 4-183* is the functional specification flow chart.


Power Off
System Off
Computer On
System On
IS
INIT
01H
Error Priority 0
Halt
OEH
IS
F
ID
IS
INIT Done
02H
F
Flash Load
0FH
FS
T#
FD
IS
Table Load
03H
F
F
Flash Loaded
0GH
IS
ZT
↴
Stop
04H
IS
RS↴
Reset
05H
RS
Aborted
0DH
AS
↴
AS,↴
RD
Load Mode ()
TF0, TF1, (TF2, TF3)
Mode Load
07H
CM
Standby
06H
CM, AS,↴
V
(verify
tables)
AS,↴
SL (0)
Load Scan
(0)
Mode Loaded
08H
CM, AS,↴
CS
The Cycle
Scan Load
09H
LS
SJ(#)/SL
(#)
Scan Loaded
0AH
Start
Condition
CM, CS, AS↴
Load Scan
SJ (#) /SL
(#)
CM, CS, AS↴
SE
Scan Executed
0CH
XS
Scan Execute
08H
CM, CS, AS↴
CM, CS, AS↴

IS - Init Start
ID - Init Done
FS - Flash Start
FD - Flash Load
T# - Table #
ZT - Stop Table Load
RS - Reset Start
AS - Abort Start
CM - Cancel Mode
V - Verify
SL - Scan Loaded
CS - Cancel Scan
LS - Load Scan
RD - Reset Done
↴ - Stop

Figure 4-183:

Troubleshooting Flow Chart

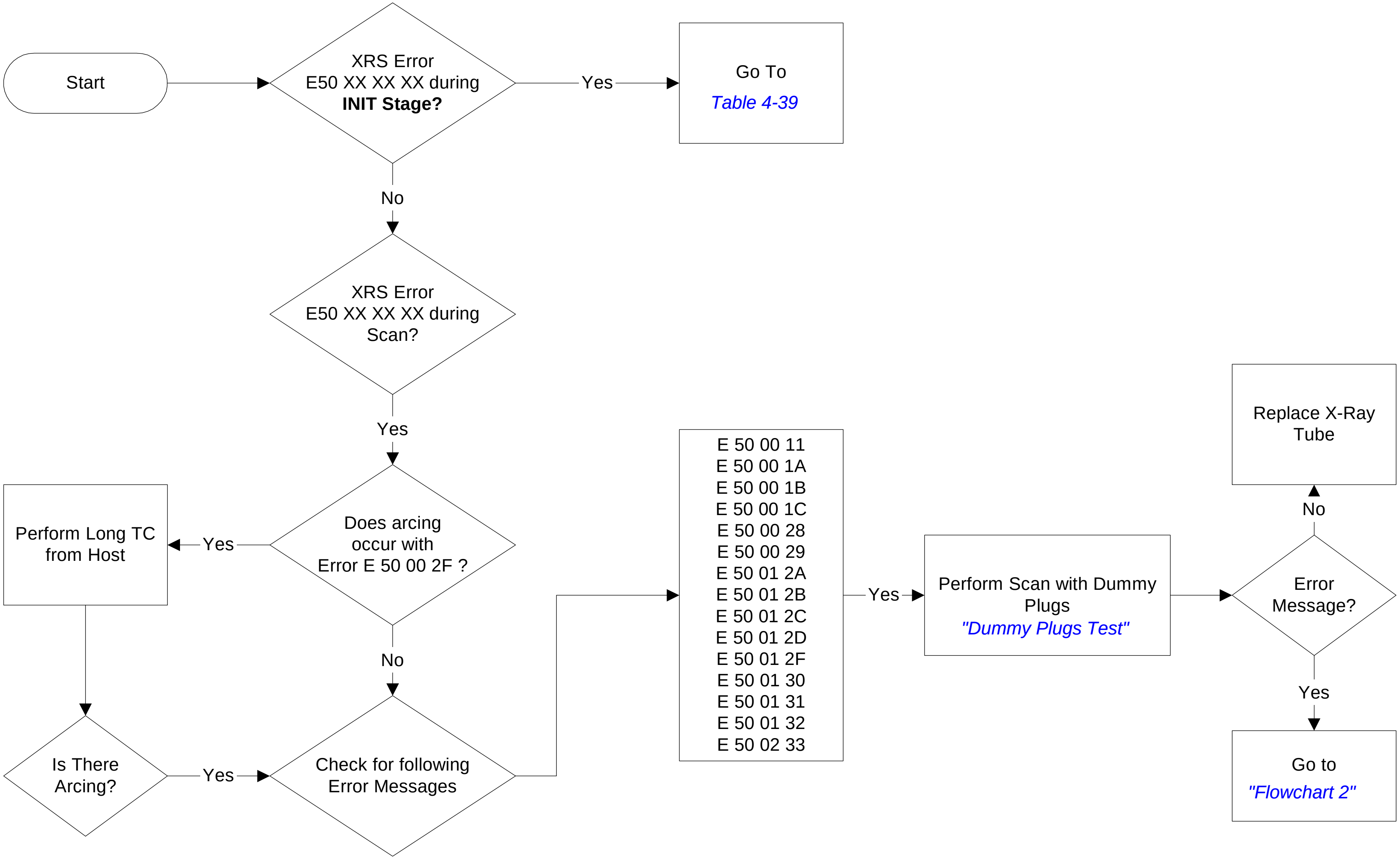
The following flow chart is based on raw data provided by engineering and should lead you to the failed FRU in most of the cases. In some cases, for example, when the x-ray tube has a major arc, E-Box components can be damaged. The diagnostics of the problem can then take longer.

Special attention should be taken while reviewing the displayed errors on the CanPro screen. Make sure to review the list for the original error immediately after the scan is executed.

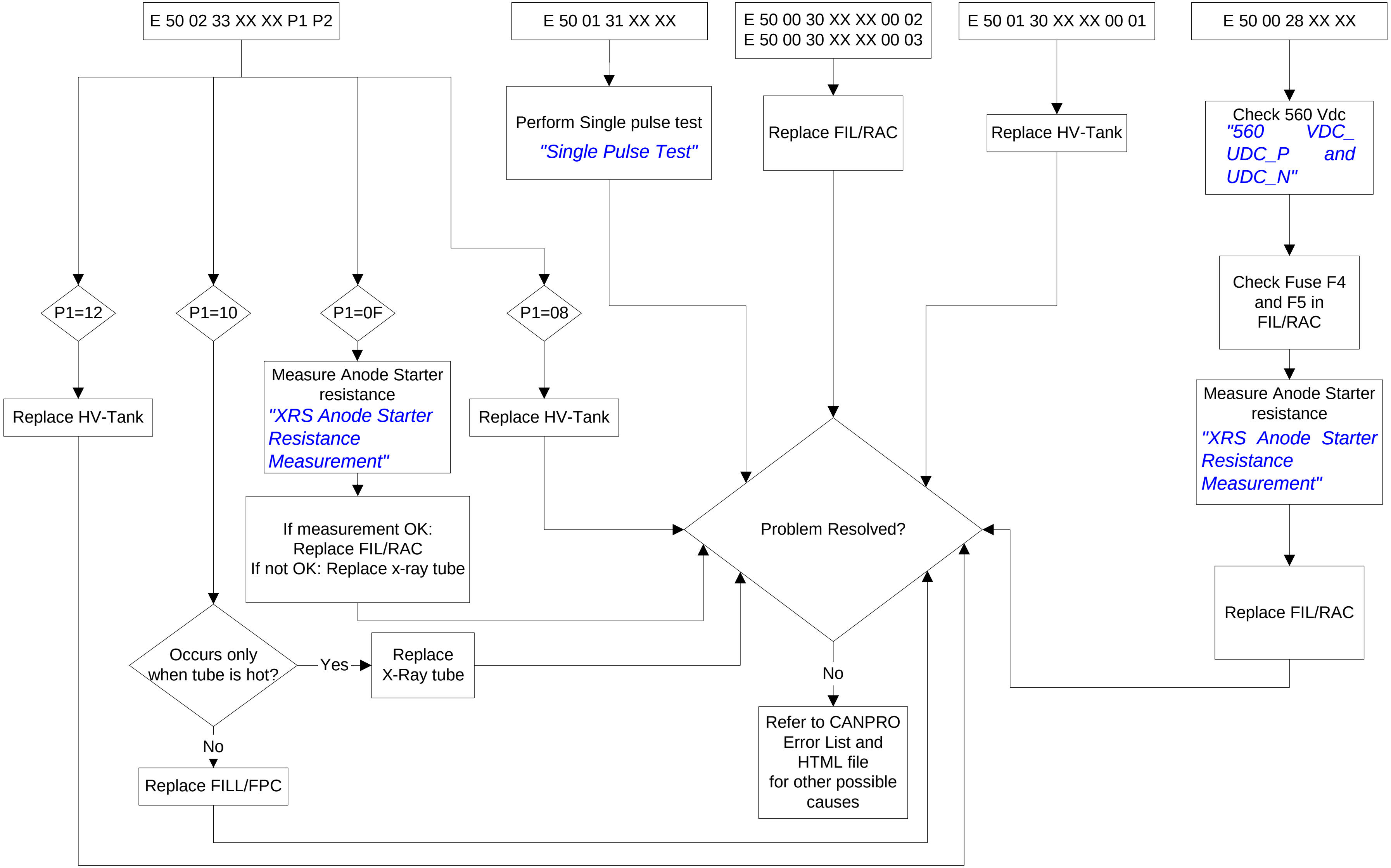
NOTE:

The Single Pulse test (see *“Single Pulse Test”*) requires a Memory Oscilloscope. This device is not a standard tool in the field. Nevertheless, we have included the test as part of this manual. A Memory Oscilloscope can be found in technical departments in some major health centers.

Flowchart 1


Start
XRS Error
E50 XX XX XX during
INIT Stage?
Yes
Go To
Table 4-39
No
XRS Error
E50 XX XX XX during
Scan?
Yes
Does arcing
occur with
Error E 50 00 2F ?
Yes
Perform Long TC
from Host
No
Is There
Arcing?
Yes
Check for following
Error Messages
E 50 00 11
E 50 00 1A
E 50 00 1B
E 50 00 1C
E 50 00 28
E 50 00 29
E 50 01 2A
E 50 01 2B
E 50 01 2C
E 50 01 2D
E 50 01 2F
E 50 01 30
E 50 01 31
E 50 01 32
E 50 02 33
Yes
Perform Scan with Dummy
Plugs
"Dummy Plugs Test"
Error
Message?
No
Replace X-Ray
Tube
Yes
Go to
"Flowchart 2"

Flowchart 2


E 50 02 33 XX XX P1 P2
E 50 01 31 XX XX
E 50 00 30 XX XX 00 02
E 50 00 30 XX XX 00 03
E 50 01 30 XX XX 00 01
E 50 00 28 XX XX
Perform Single pulse test
"Single Pulse Test"
Replace FIL/RAC
Replace HV-Tank
Check 560 Vdc
"560 VDC_UDC_P and UDC_N"
P1=12
P1=10
P1=0F
P1=08
Check Fuse F4 and F5 in FIL/RAC
Replace HV-Tank
Measure Anode Starter resistance
"XRS Anode Starter Resistance Measurement"
Replace HV-Tank
Measure Anode Starter resistance
"XRS Anode Starter Resistance Measurement"
If measurement OK: Replace FIL/RAC
If not OK: Replace x-ray tube
Problem Resolved?
Replace FIL/RAC
Occurs only when tube is hot?
Yes
Replace X-Ray tube
No
No
Refer to CANPRO Error List and HTML file for other possible causes
Replace FILL/FPC

The following errors can be caused by more than one malfunction. Column I lists the most likely malfunction. If the problem persists after changing the part in column I, proceed to column II, and then to column III.

Table 4-39: XRS Message List

XRS ERROR	NOTES	I	II	III
E50 00 10 (INIT)	Reload XRS FW. Verify that you are using the correct version.	MCB (D-400*)		
E50 00 11 (INIT)		D-400*	MCB	
E50 00 12 (INIT		D-400*	E-Box*	
E50 00 13 (INIT)	Perform Single Pulse test (see *"Single Pulse Test"*).	D-400*	E-Box*	HV-Tank*
E50 00 14 (INIT)	Perform Single Pulse test (see *"Single Pulse Test"*).	D-400*	E-Box*	HV-Tank*
E50 00 15 (INIT)	Check cable D400—D432.	D-400*	HV-Tank*	
E50 00 16 (INIT)	If parameter 2=03, check cable D400—D115.	D-400*	Fil/RAC	X-ray Tube
E50 00 17 (INIT)		D451 (IN PDC)	D-400*	
E50 00 18 (First Reset)	For parameter 2: a. If parameter 2=(01 up to 0A), check x-ray tube filament resistance. You can also install dummy plugs; this simulates the filament on the x-ray tube. Keep the service switch S301 off. Turn on the Gantry power. If no error occurs during reset, this indicates that the x-ray tube is bad (see *"X-ray Tube Filaments Resistance Measurements"*).	Fil/RAC	D-400*	HV-Tank*
	b. If parameter 2 = 0B, this is an error which generally indicates that major arcing occurred which may damage the Fil/RAC. It is recommended to order a new x-ray tube and Fil/RAC.	Fil/RAC X-ray Tube		
E50 00 1E	Check E-Box fans and F2 fuse (XRS fans and M1 through M4) and F3 fuse (Fil/RAC and HV-Tank fans).	Fil/RAC		

*** FREQUENCY ADAPTATION MUST BE PERFORMED SUCCESSFULLY FOLLOWING THE REPLACEMENT OF:**

- D-400
- HV-Tank
- E-Box

IF NOT, SOME SCANS MAY FAIL WITH XRS E55 50 00 29

Table 4-39: XRS Message List

XRS ERROR	NOTES	I	II	III
E50 00 21	Check fuse F3 (HV-Tank fans) and connection D400 (X-7)—D432 (X-6).	HV-Tank*	D-400*	
E50 00 22 (INIT)	Check E-Box fans and F2 fuse (XRS fans and M1 through M4) and F3 fuse (Fil/RAC and HV-Tank fans).	D-400*	E-Box*	
E50 00 23 (INIT)	Check E-Box fans and F2 fuse (XRS fans and M1 through M4) and F3 fuse (Fil/RAC and HV-Tank fans).	D-400*	E-Box*	
E50 00 24	Verify that connector X-8 on D432 is properly connected.	HV-Tank*	D-400*	
E50 00 25	Check the voltage on the generator PS (E606) attached to the E-Box (see *Table 4-40*).	Generator PS—E606	D-400*	
E50 00 26	Check the voltage on the generator PS (E606) attached to the E-Box (see *Table 4-40*).	Generator PS—E606	D-400* E-Box*	
E50 00 27	Check the voltage on the generator PS (E606) attached to the E-Box (see *Table 4-40*).	Generator PS—E606	D-400* E-Box*	
E50 01 30 (First Reset)	Check x-ray tube filament for resistance (see *"X-ray Tube Filaments Resistance Measurements"*).	Fil/RAC		
E50 01 32	If the x-ray tube anode bearing is very noisy, replace the x-ray tube.	Fil/RAC	X-ray Tube	
E50 01 34	If parameter 1=02, the supplied DC voltage from the stationary part is too low. Check 560VDC F100—Fuses (80A in PDC unit)	F100 Fuses in PDC unit	560 VDC PS in the PDC	
E50 00 36 (INIT)		E-Box*		

*** FREQUENCY ADAPTATION MUST BE PERFORMED SUCCESSFULLY FOLLOWING THE REPLACEMENT OF:**

- D-400
- HV-Tank
- E-Box

IF NOT, SOME SCANS MAY FAIL WITH XRS E55 50 00 29

Table 4-40: E606 and UDC Power Supplies

POWER SUPPLY	VOLTAGE	TOLERANCE	MEASURING POINT	E606 LOCATION
E606	5 V	±5%	At E606	Slot 1
E606	15 V	±5%	At E606	Slot 2
E606	–15 V	±5%	At E606	Slot 3
E606	15 V	±5%	At E606	Slot 3
E606	+24 V	±5%	At E606	Slot 4*
E606	+24 V	±5%	At E606	Slot 5*
UDC	560 V Nominal	Dependent on Line Voltage	D400 X130 UDCact	N/A

*. slot 4 and 5 are connected in series to make 48V

General Diagnostic Tools and Procedures

560 VDC_ UDC_P and UDC_N

The 560 V DC UDC_P and UDC_N should be measured prior to starting the diagnostics. Many errors can be related to improper voltage because all major x-ray systems use this initial power.

a. The E-Box—use it for the ignition circuit of inverters.
b. Fil/RAC—use it for the filament power and for the RAC power.

The UDC voltage may vary because it depends on the line voltage. If a transformer is used (i.e., the line voltage is other than 400V), the UDC voltage must be 560 V ±10%.

During a scan, the voltage drop of UDC should never be more than 80 V below the actual UDC voltage. If the UDC voltage drops by more than 80 V during an exposure, there can be a missing phase in the PDC. Check the three F100 (80 A) fuses. If one F100 (80 A) fuse is defective, replace all three.

UDC is transferred as follows:

- From D-450 X7–X10 in the PDC via the W3 cable to the X303 connection in the right leg of the Gantry.
- From the X303 connection in the right leg of the Gantry via the X315 cable to the slip ring connections X382 and X383.
- From slip ring connections X382 and X383 via the W505/W506 cables to the x-ray system.

Frequency Adaptation Calibration

Introduction

Frequency adaptation is an automatic program running via scenario in CANpro. This procedure may still be used in the event that the automated calibration does not work properly. The purpose of the program is to adapt the inverters frequencies for maximum performance along the required frequencies. The program performs very short scans in different frequencies, and records the results in the main control D400. The procedure must be performed each time one of the following parts is replaced:

- The HV-Tank
- The Electronic Box
- The D400 Card

The frequency adaptation procedure must complete successfully. If not, the current frequency parameters are lost and no scan is possible. Failure of the procedure could be due to any x-ray fault.

The manufacturer tests each E-Box and D400 prior to shipment, therefore some frequency adaptation already exists. It is highly recommended to perform some scans prior to the frequency adaptation procedure to verify that the HV system is operational. If the system fails, follow the troubleshooting guide. **Do not attempt to perform the frequency adaptation unless the system is operational**. X-ray tube minor arcing can cause failures, which terminates the frequency adaptation program. In this case, perform frequency adaptation with the Dummy Plugs connected.

Tools:	None
Estimated Time:	30 Min.

Procedure

1. Lower the bed to minimum height.
2. Turn OFF the Gantry from the CT-Box and open the Gantry front cover.
3. Turn the service switch S301 on the Gantry to **0**.

WARNING

ELECTRICAL HAZARD!

DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES. BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

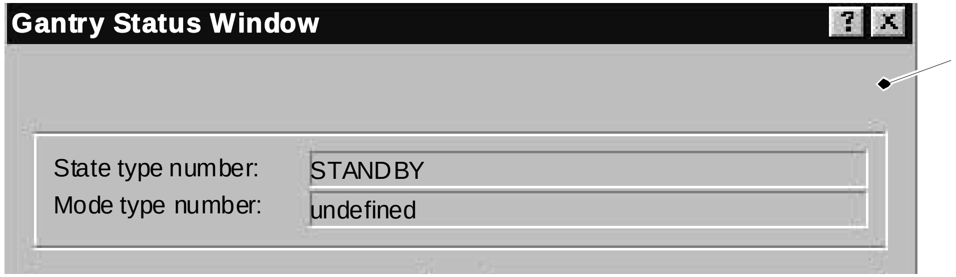
- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE GANTRY STATIONARY ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_POS AND UDC_NEG AT THE FOLLOWING POINTS:**
  - **IN THE STATIONARY GENERATOR**
  - **ON THE SLIP RING AT THE BACK OF THE GANTRY**
  - **ON THE ELECTRONIC BOX OF THE GENERATOR**

NOTE:

It is a good idea to use the Dummy Plugs for this procedure even though it is not mandatory. Tube Arcs that occur during the procedure can drive the inverters to resonance, resulting in destruction of the inverters, Tube and/or the E-Box.

4. Remove the high-tension cables from the HV-Tank.
5. Insert the dummy plugs (P/N sp711621791) in the HV-Tank outlets.
6. Turn the Gantry ON from the CT-Box.

7. Login to the Host computer.
8. When the Application software is running on the host computer:
   - — CANpro 7.5 / 8: keep the application system login.
9. If CANpro is not already running, start CANpro:
   - — CANpro 7.5 / 8: Create a new protocol file—select **New**, **Protocol** from the **File** menu and click **Create**.
10. In CANpro, select **Start** from the **Monitor** menu.
11. Check system state (target state = standby):
    - — CANpro 7.5 / 8: Select **Gantry Status** from the Monitor menu. System state is displayed at the top (see *Figure 4-184*).



State type number: STANDBY
Mode type number: undefined

Function available under Monitor menu in CANpro 4.8

Figure 4-184: Determine System State

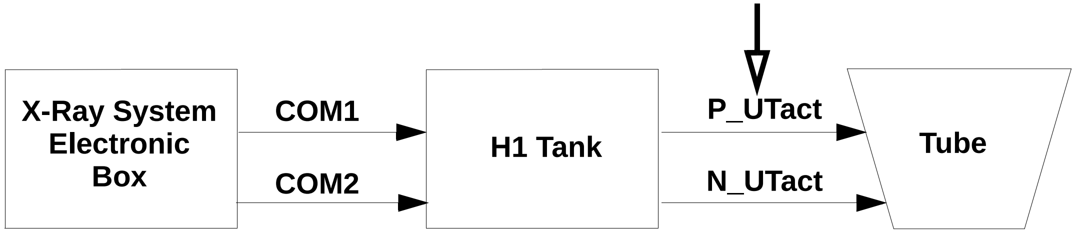
12. If the system is not in standby, press the Stop button on the CT Box. Select the following software-dependent actions and repeat step 11 or continue on to step 13:
    - — CANpro 7.5 / 8: Click the “Send Reset Telegram” button (upper right-hand side of toolbar). Watch for the CAN message “Reset Done” and the arrows above the motion control buttons on the CT Box to light up.
13. Select **Simulation | Load** from the **Monitor** menu, select the following scenario, and click **OK**.
    - — CANpro 7.5 / 8: **c:\canpro\machines\"machine name"\scenario\adjust\frequency_adaption\F_ADAPT.TSC**.
14. Click on **Simulation, Start F_ADAPT.TSC** to run the program.
15. You are prompted to “wait for LS from MCU to ICS, then execute premeasurement”. Wait for the message “LoadedScan from the MCU to ICS and then click **OK**.
16. At this point, the system is forced into a special test mode in which a number of short scans are performed. You are prompted to “Wait for LS 0x00 from MCU to ICS and then cancel mode”. Click **OK** when the message “LS 0x00 from MCU to ICS” appears.

17. Select **Stop** from the **Monitor** menu to stop CANpro monitoring.
18. Scroll upwards until you find the “last” occurrence of T5e and double-click on the line containing T5e. Verify that there were no tube arcs during the time the scenario was running. If any arcs occurred, repeat the procedure starting at step 14.
19. Turn the system off, remove the Dummy Plugs and reinstall the inverters.
20. Apply power to the system and log in to the application software.
21. Check for proper operation of the High Voltage system by performing scans from the host computer at 90, 120 and 140KV.

NOTE:

140 kV scanning is not possible with any Head protocol. Select an Abdominal protocol for this check.

Dummy Plugs Test



Use the Dummy Plugs test to isolate either the x-ray tube or High Voltage Tank as the typical cause.

The Dummy Plugs test detects high tension arcing or high tension breakdown. During this test, high tension is applied to the high tension circuit without tube current. High tension in the circuit is applied with the use of test plugs, to isolate high tension faults to either the tube or the H1 tank.

To perform this test, you need test plugs. The Dummy Plugs test includes the following:

- Maximum power at 140 kV.
- Anode rotation.
- No filament current.

NOTE:

- The results of Dummy Plugs test are valid only when an error occurs also with Customer Modes. This is due to the nature of the **HV_Drop** signal.
- When the tube is installed, radiation is produced. Use suitable protection.
- Performing Dummy Plugs test with the tube installed can lead to misdiagnosis and failures.

Procedure

Perform the Dummy Plugs test as follows:

1. Lower the bed to minimum.
2. Turn OFF the Gantry from the CT-Box and open the Gantry front cover.
3. Turn the service switch **S301** on the Gantry to 0.

WARNING

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

4. Remove the high-tension cables from the HV-Tank.
5. Insert the dummy plugs (P/N sp711621791) in the HV-Tank outlets.
6. Turn the Gantry ON from the CT-Box.
7. Login to the Host computer.
8. Verify that the system has reached Stand-by and logout from the Host.
9. Activate the CANpro program from the computer.
10. Load the following scenario:
    \diag\xrs_tst\xrs_test\s_hvtest.tsc
11. Run the scenario.

NOTE:

It is very important to wait for 15 minutes between exposures to allow for the high voltage to discharge.

12. When measurement is finished, check the **CANpro Log**.
    If there is an error, the fault is in the HV-Tank.
    If there is no error, the tube is defective.

NOTE:

Before replacing the tube, perform Short TC and Long TC to restore stable operation.

XRS Anode Starter Resistance Measurement

The anode starter resistance can be measured directly via the connector on the x-ray tube and via the cable connected to the E-Box. Improper connection and cable securing have frequently been found to cause anode rotating errors.

The following errors can be associated with the anode starter and cable connections.

XRS error 50 01 32 xx xx 02 40
XRS error 50 01 32 xx xx 03 00
XRS error 50 02 33 xx xx 10 63

The errors indicate problems with the anode starter rotation speed test.

NOTE:

Make sure that the anode starter has stopped completely prior to measurement. If it is still running, incorrect measurement values are obtained.

Procedure

1. Lower the bed to minimum.
2. Turn OFF the Gantry from the CT-Box and open the Gantry front cover.
3. Turn the service switch **S301** on the Gantry to 0.

WARNING

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

4. From field experience we know that improper tightening of anode starter cable W-513 causes the errors mentioned at the beginning of this section. This is due to gravitational forces applied on the cable during rotation. *Figure 4-185* illustrates the proper method of securing the cable.

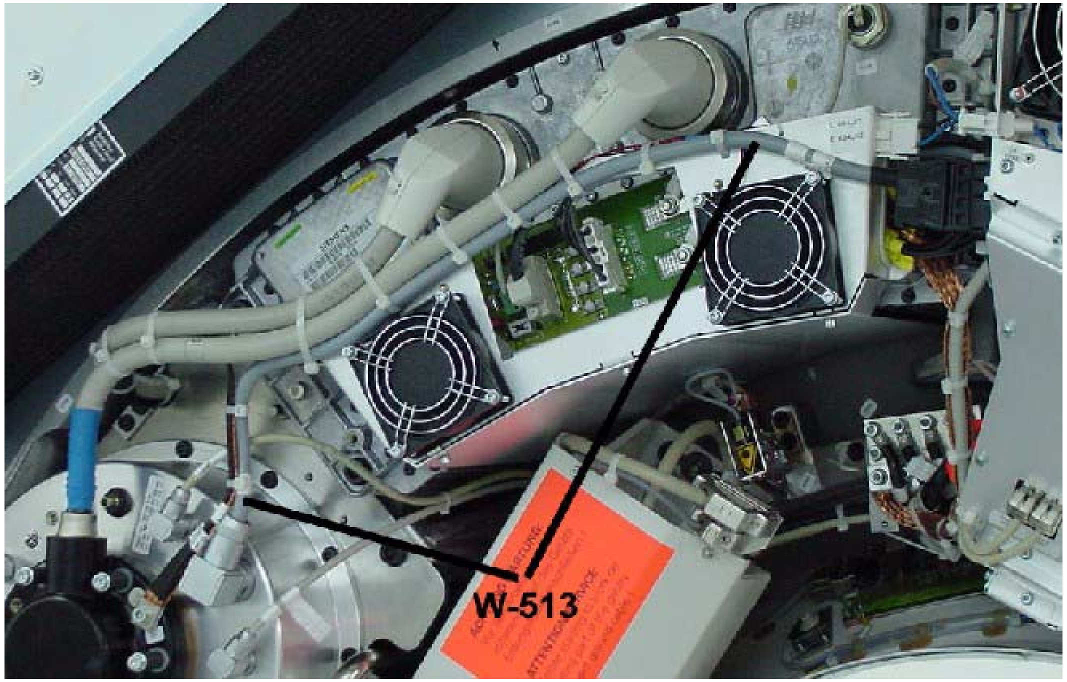


Figure 4-185: Cable W-513

X-ray Tube Filaments Resistance Measurements

The x-ray tube has two filaments: one small and one large.

The XRS system performs an initial test of both filaments during the "Reset Stage": first the small filament and then the large one. At the end of the reset stage the large filament stays in the stand-by mode (4.5 A). If any of the filaments are open, the following error is issued:

XRS E 50 00 18

NOTE:

Make sure that the anode starter has stopped completely prior to measurement. If it is still running, incorrect filament measurement values are obtained.

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

Procedure

1. Lower the bed to minimum.
2. Turn OFF the Gantry from the CT-Box and open the Gantry front cover.
3. Turn the service switch **S301** on the Gantry to 0.
4. Disconnect the cathode side of the HV cable from the HV-Tank.
5. With a voltmeter, measure the filament resistance on the cable end:
   - Between C-(common) and L-(large filament)—1.3Ω
   - Between C-(common) and S-(small filament)—0.5Ω

Single Pulse Test

Use Single Pulse test to isolate either the Electronic Box or High Voltage Tank as the typical cause.

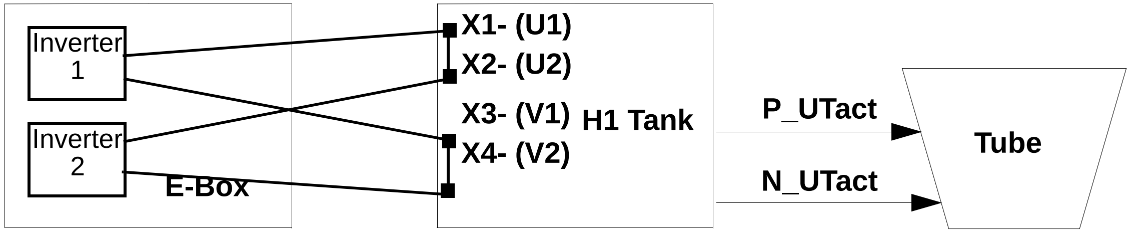

Inverter 1
Inverter 2
E-Box
X1- (U1)
X2- (U2)
X3- (V1)
X4- (V2)
H1 Tank
P_UTact
N_UTact
Tube

Figure 4-186: Single Pulse Test Block Diagram

The Single Pulse test isolates a fault between the inverter (E603 electronic box) and the HV-Tank (E604) by triggering the inverters for a single pulse.

Procedure

1. Lower the bed to minimum.
2. Turn OFF the Gantry from the CT-Box and open the Gantry front cover.
3. Turn the service switch **S301** on the Gantry to 0.
4. Rotate the Gantry rotor to gain access to the E-Box.
5. Remove the E-Box cover.
6. On D-400, connect a **MEMORY SCOPE** with two channels to:
   - — Test field X230—I_load (see *Figure 4-187*) 1 V = 50 A
   - — Test field X260—Start_Inv (see *Figure 4-188*) Each test field has a 0 V point for reference.
7. Connect Channel 1 to I_Load. Channel 2 is the trigger. Connect it to Start_Inv.
8. Adjust:
   - — Channel 1 to 1V/division
   - — Channel 2 to 5V/division Time base 2 μsec/division

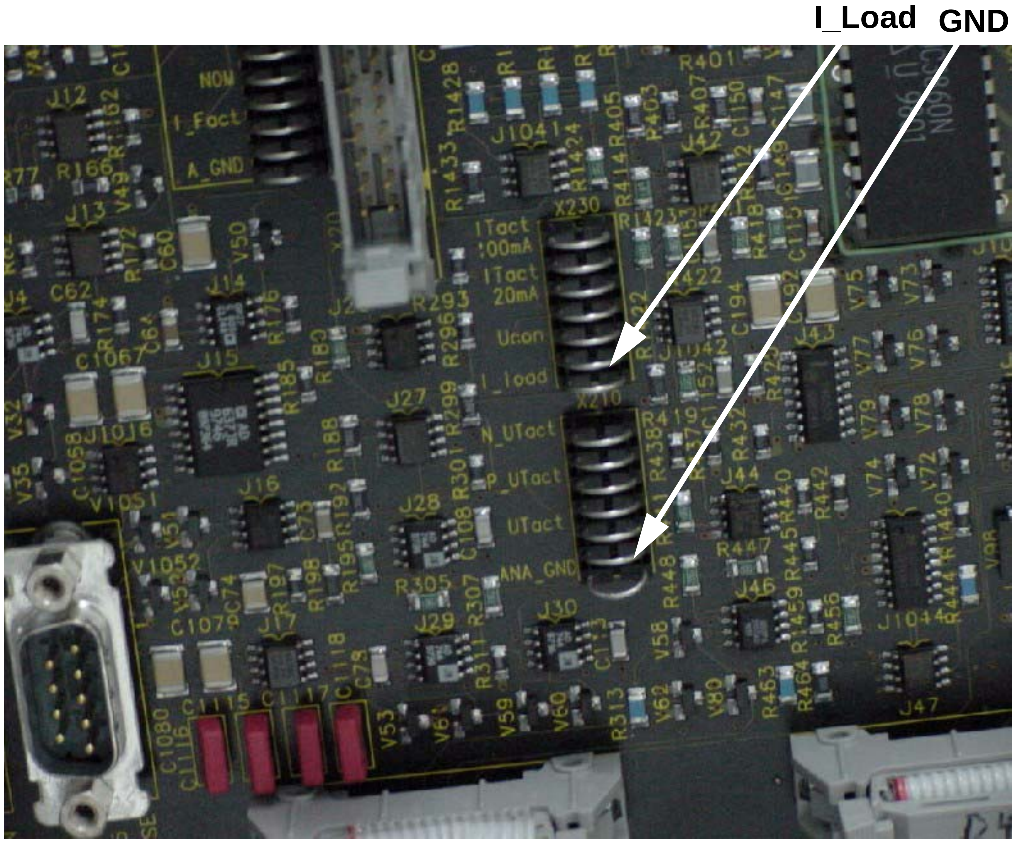


Figure 4-187: Test Field X230

9. Turn ON the Gantry power from the CT-Box.
10. Activate the CANpro program from the computer.
11. Load the following scenario: **\scenario\diag\xrs_tst\xrs_test\single_p.tsc** Run the scenario a minimum of twice. Each scan alternates between the negative inverter and the positive inverter. Therefore, the first scan is the negative side and the second scan is the positive side.

Test results are based on an evaluation of the I_load signal according to the following parameters:

- The time for a single pulse must be nine µseconds ±20%.
- The peak current must be 150 A ±20%.
- Evaluate both negative and positive pulses.

12. Observe the signal on the scope and compare to the following figures and descriptions. On the basis of this comparison, you can conclude which of the FRUs is faulty: E-Box or HV-Tank.

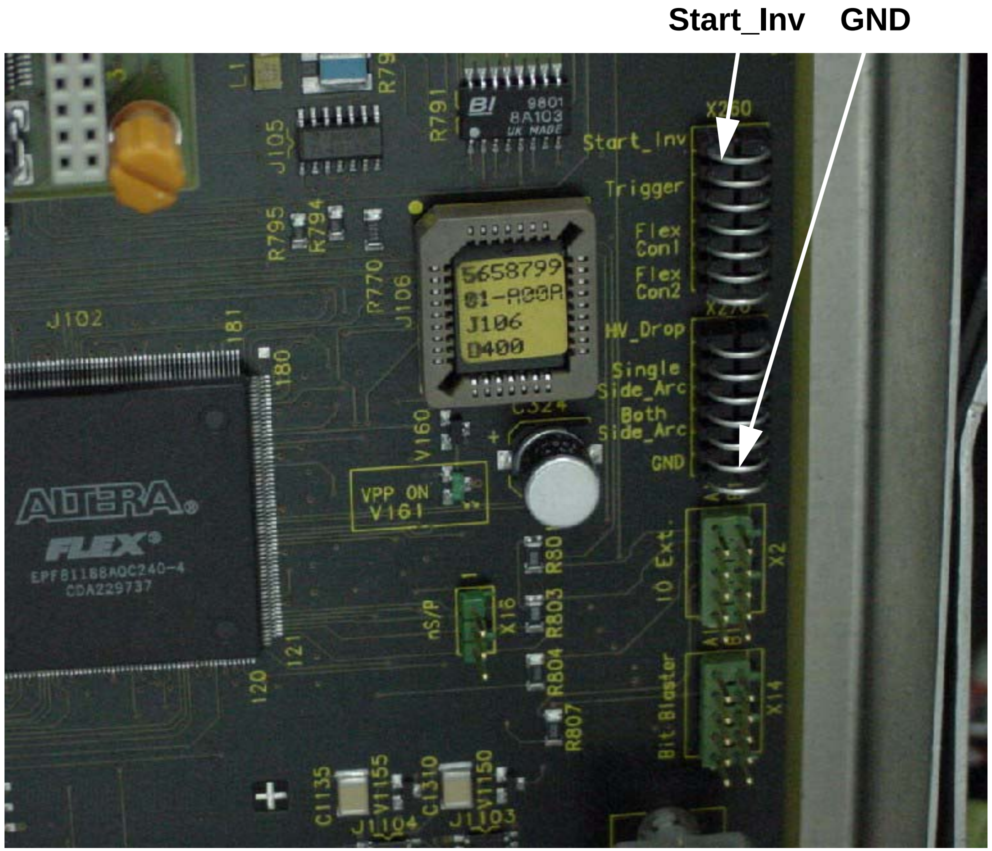

Start_Inv
GND
X260
Start_Inv
Trigger
Flex Con1
Flex Con2
HV_Drop
Single Side_Arc
Both Side_Arc
GND
ALTERA
FLEX
VPP ON V161
IO Ext
X2
Bit Blaster
X14

Figure 4-188: Test Field X260

Figure 4-189 and *Figure 4-190* represent a nominal no-fault operational system.

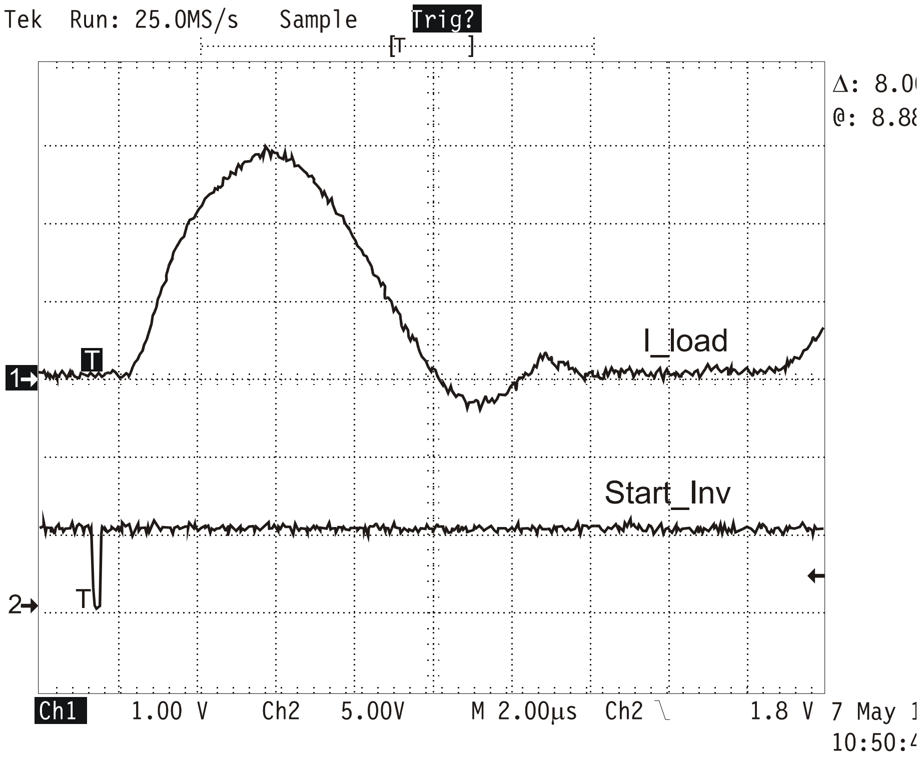


Figure 4-189: Single Pulse Oscillogram, Peak 150 A (Positive)

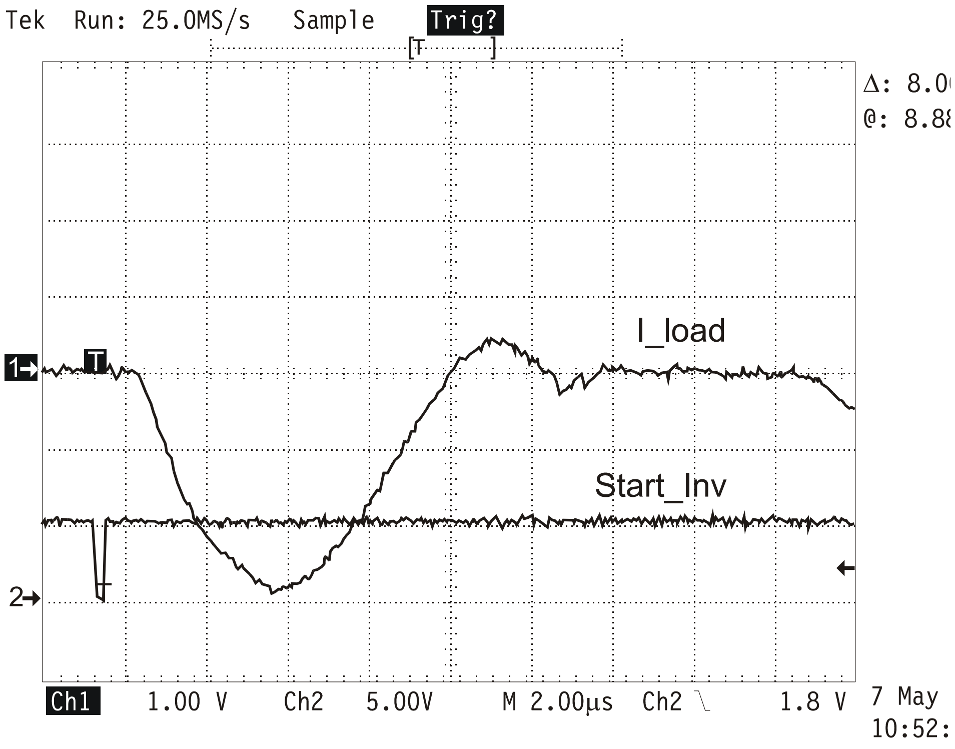


Figure 4-190: Single Pulse Oscillogram, Peak 140 A (Negative)

Figure 4-189 illustrates a positive wave form of a single pulse that lasts for eight µseconds. It measures the time between the peak and the return to zero. The peak in this wave form approaches 150 A.

Figure 4-190 illustrates a positive wave form of a single pulse that lasts for eight µseconds. It measures the time between the peak and the return to zero. The peak in this wave form approaches 140 A.

Figure 4-191 and *Figure 4-192* are examples of a faulty HV-Tank.

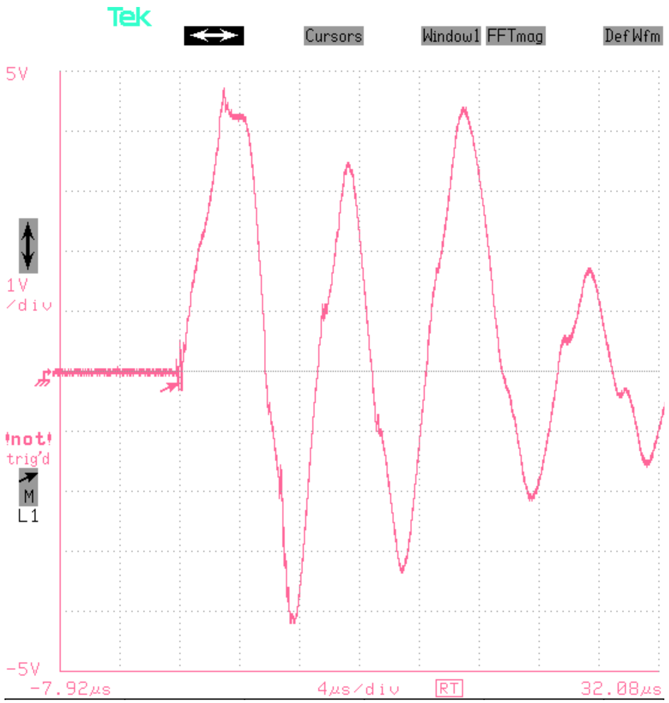


Figure 4-191: I-Load Signal Positive Side

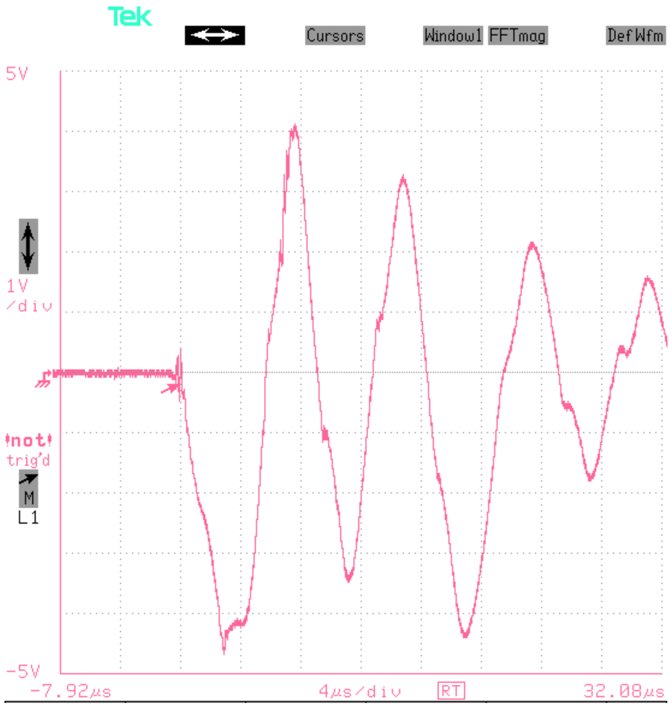


Figure 4-192: I-Load Signal Negative Side

Figure 4-191 and *Figure 4-192* represent a problem when there is a short circuit between X3, X1 and X4—a short circuit across the current sensor exists. The current which flows in the current sensors oscillates in this short circuit after switching off the inverter. The first pulse is switched off by the UCE-supervision of the inverter. Duration of the first pulse is six µseconds, the maximum amplitude is 250 A.

This short circuit has the same effects as a short circuit of one high voltage transformer inside the HV-Tank. A shorted transformer leads to a short circuit across X1 and X2 or X3 and X4, respectively (see *Figure 4-186*).

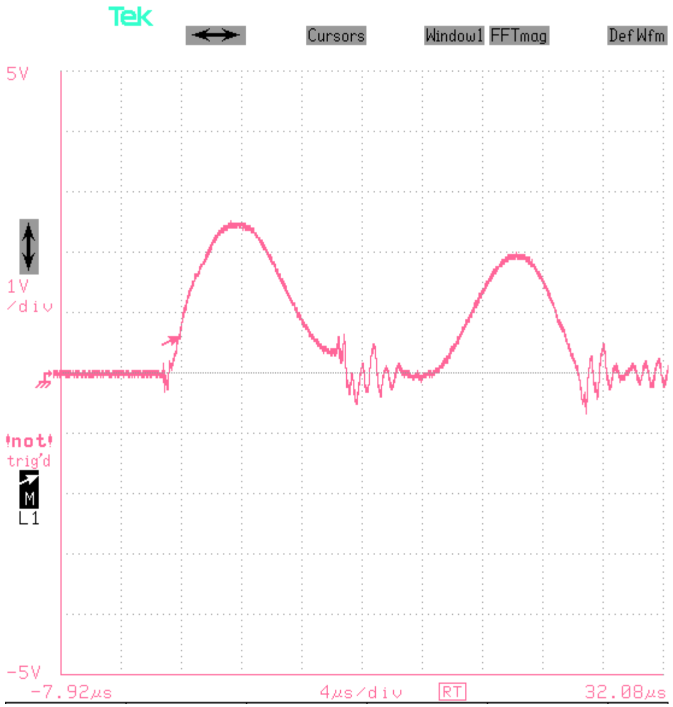

Tek
Cursors
Window1 FFTmag
DefWfm
5V
1V
/div
!not!
trig'd
M
L1
-5V
-7.92µs
4µs/div
RT
32.08µs

Figure 4-193: I-Load Signal Positive Side

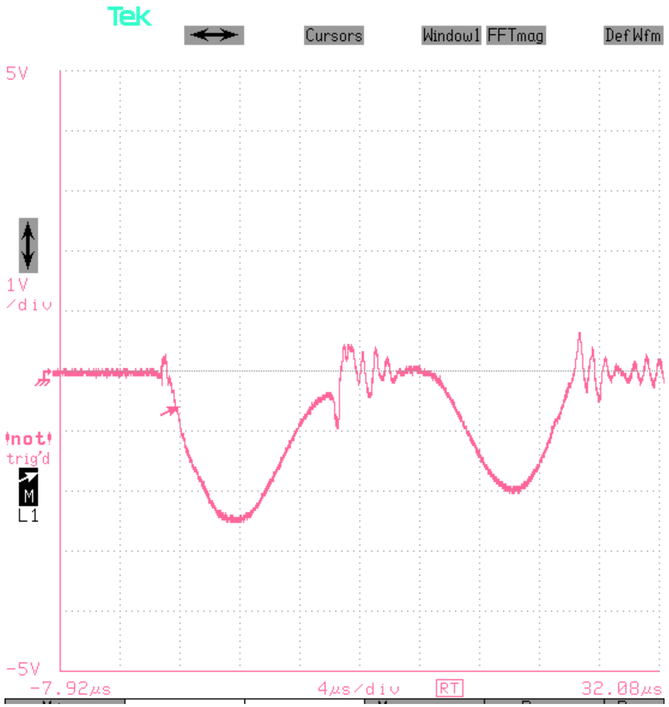

Tek
Cursors
Window1 FFTmag
DefWfm
5V
1V
/div
!not!
trig'd
M
L1
-5V
-7.92µs
4µs/div
RT
32.08µs

Figure 4-194: I-Load Signal Negative Side

Figure 4-193 and *Figure 4-194* are examples of an open circuit in the input the high voltage transformer.

x4 is not connected (no wire and no connection plate to X2). Therefore, the stray inductance of the HV-Tank has twice the value as in normal operation, because one high voltage transformer is not connected. Because of this, the resonance frequency decreases so much, that the first pulse is switched off by the pulse limitation of the UCN 3860. There is a very small following pulse with inverse polarity. Duration of the first pulse: 12 µs, maximum amplitude: 125 A.

Replacing the X-Ray Tube

Tube replacement is a two-step procedure:

a. Tube Cooling membrane inspection
b. X-ray tube replacement

Tube Cooling Membrane Inspection

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

This section clarifies the procedure for checking the tube cooling membrane. Perform this procedure prior to dismantling the tube and after installing the new tube.

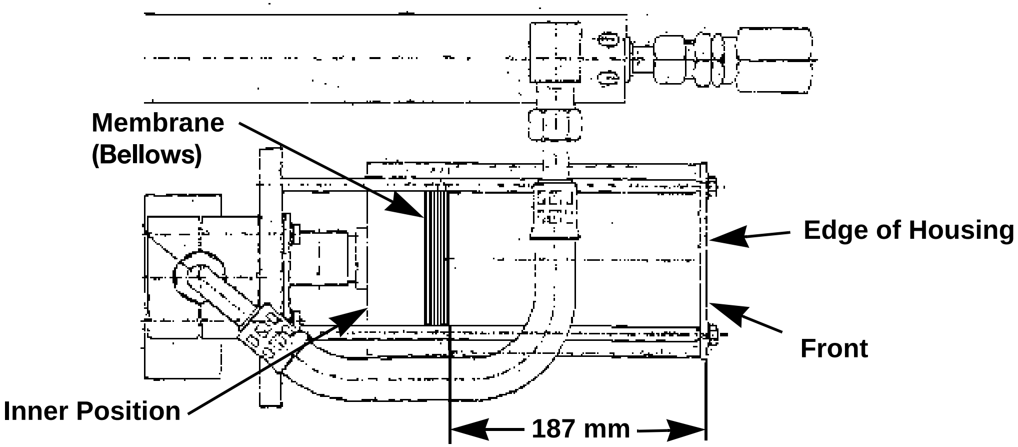


Figure 4-195: Membrane Adjustment

There have been several reports from the field that the membrane was contracted to more than its inner position (see *Figure 4-195*). This is the result of a leaking tube; oil from the expansion vessel flowed into the tube.

Procedure

Check the expansion membrane of the tube cooling system before each tube replacement. If the expansion membrane is contracted to more than its inner position (max. 187 mm from edge of its housing—see *Figure 4-195*), both the tube and the tube cooling unit must be replaced. Only this action guarantees that the oil-filled cooling circuit is homogeneously filled with oil. Otherwise, the new tube will be damaged and will need to be replaced prematurely.

X-ray Tube Replacement

These instructions contain important information on the tools and auxiliary materials required. Read these instructions completely before replacing the tube system.

Use the tools and auxiliary materials recommended in these instructions.

Follow all general safety guidelines and radiation protection ordinances (see *"Safety Guidelines"*).

Secure all lines and cables with cable ties or cable clamps at the locations indicated to ensure that they match their original status.

⚠ WARNING ⚠

ELECTROCUTION HAZARD. REMOVE POWER FROM THE WALL BOX BEFORE WORKING ON EQUIPMENT WITH COVERS REMOVED. HIGH A/C VOLTAGE IS EXPOSED IN MANY LOCATIONS AND 560VDC IS PRESENT ON THE ROTOR SLIP RINGS. ALLOW 5 MINUTES FOR THE PDC CAPACITORS TO DISCHARGE BEFORE WORKING ON THE EQUIPMENT. FAILURE TO COMPLY WILL RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

⚠ WARNING

ROTATING MACHINERY. DO NOT BEGIN WORKING ON THE GANTRY UNTIL THE ROTATION SWITCH S301 IS SET TO THE "0" (ROTATION DISABLED) POSITION.

STAND CLEAR OF THE GANTRY WITH THE COVERS REMOVED WHILE THE ROTATING FRAME IS IN MOTION. FAILURE TO COMPLY MAY RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

Tools and Auxiliary Materials Required

You need the following tools and auxiliary materials:

- A standard set of service tools
- 3 Nm - 20 Nm torque wrench with a 4 mm (1/4") Allen attachment
- 25 Nm - 130 Nm torque wrench with an 8 mm (1/2") Allen attachment
- 1/2" extension
- 13 mm torque wrench
- 90 Nm torque meter
- Liquid silicon, silicon disks and silicon rings for the high voltage connectors
- Handle for facilitating removal of the X-ray tube (included with every X-ray tube)
- Pad for tabletop and 1.5 m belt for securing the tube
- 5 mm and 6 mm Allen keys
- A pipe wrench for the X-ray tube cooling hoses

Preparations

Prepare for replacement of the X-ray tube as follows:

1. Move the patient table MAX down and MAX out.
2. Open the front cover of the Gantry and set the S301 switch to the "0" position.
3. Position the X-ray tube at the 6 o'clock position and close the safety locking pin to prevent Gantry rotation.
4. Switch the Gantry OFF using the Gantry OFF switch on the CT Box.

WARNING

ELECTROCUTION HAZARD. HIGH A/C VOLTAGE IS EXPOSED IN MANY LOCATIONS AND 560 V DC IS PRESENT ON THE ROTOR SLIP RINGS. ALLOW 5 MINUTES FOR POWER TO BLEED OFF THE PDC CAPACITORS BEFORE

WORKING ON THE EQUIPMENT. THE CAPACITOR BANK IS DISCHARGED TO APPROXIMATELY 40 V DC WHEN THE TWO LEDS ON D450 ARE OFF. FAILURE TO COMPLY WILL RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

5. Remove the lower front cover of the Gantry by releasing the six 10 mm nuts—Three on each side (see *Figure 4-196*).
6. Place switch S1 in the PDC to the ON position.

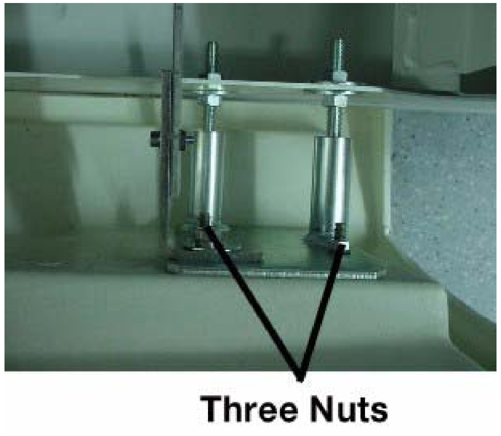


Figure 4-196:

⚠ WARNING

MECHANICAL HAZARD! THE NEXT STEP REQUIRES YOU TO SET THE SERVICE SWITCH S703 TO THE SERVICE POSITION. WITH SERVICE SWITCH S703 SET TO THE SERVICE POSITION, THERE IS NO UPPER AND LOWER HEIGHT LIMIT. THE SCISSORS CARRIAGE CAN BE DRIVEN INTO THE SUB-FRAME. EXERCISE EXTREME CAUTION WHEN RAISING OR LOWERING THE PATIENT TABLE WITH SERVICE SWITCH S703 IN THE SERVICE POSITION. FAILURE TO COMPLY CAN RESULT IN *SERIOUS INJURY OR DEATH* TO SERVICE PERSONNEL OR SERIOUS DAMAGE TO THE EQUIPMENT!

7. Remove the Patient Table sub-frame cover to expose the Patient Table service panel (see *Figure 4-197*.
8. Set Service Switch S703 to the Service Mode. Position 1 enables the Service Mode; position 0 disables Service Mode.
9. Raise the Patient Table to a high position with switch S701, leaving room for upward vertical motion required later in the procedure.

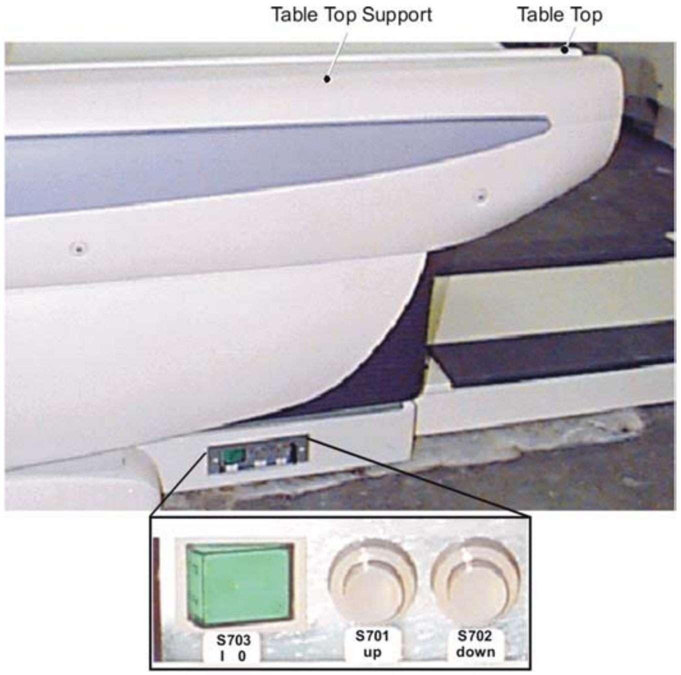


Figure 4-197: Patient Table Service Panel

Removing the Old X-Ray Tube

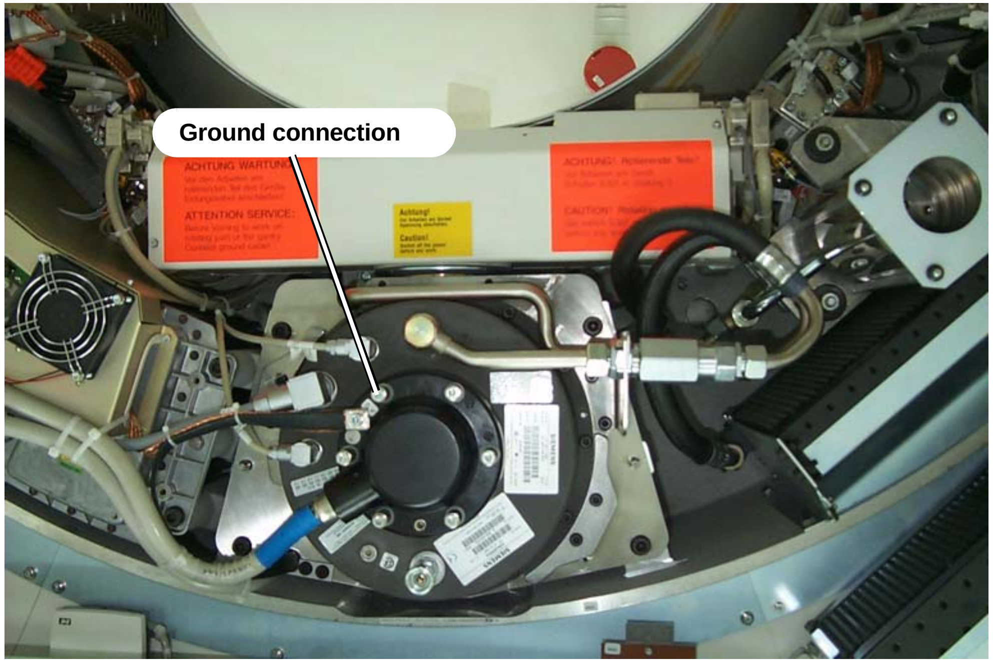


Figure 4-198:

Remove the old X-ray tube as follows:

1. Disconnect the cable and connectors (X4, X5 and X6) from the X-ray tube (see *Figure 4-199*).

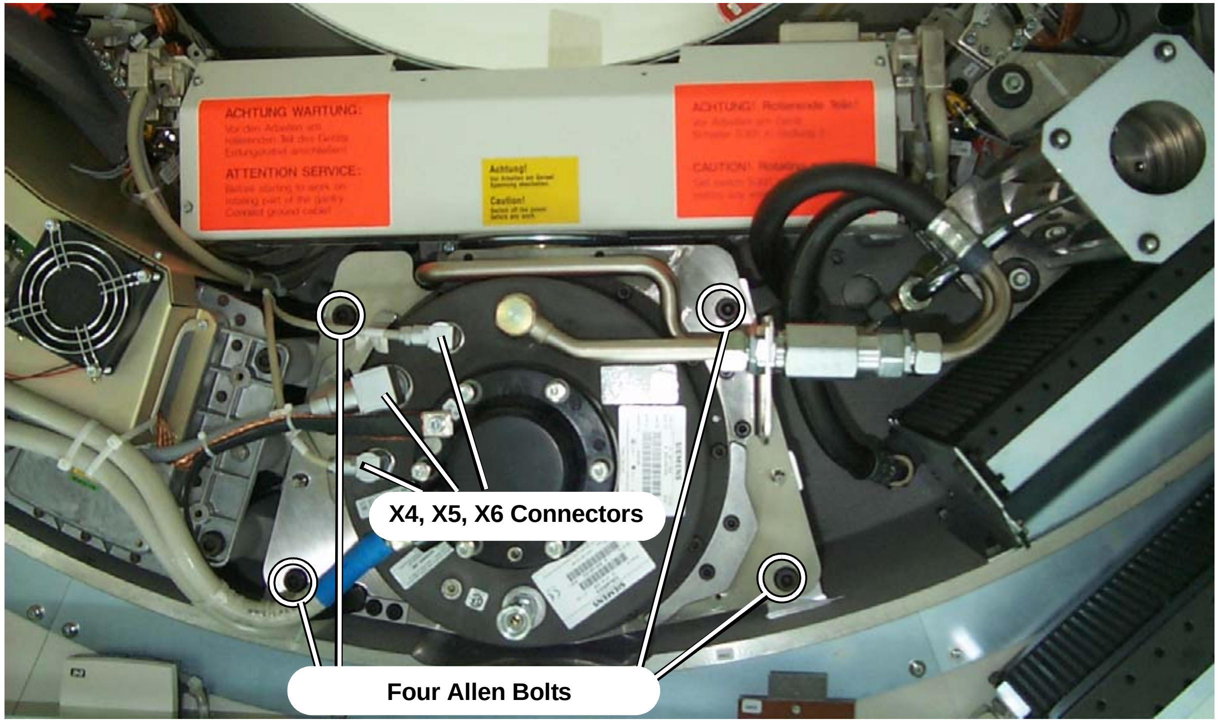


Figure 4-199: X-Ray Tube Connectors

2. Disconnect the ground connection at the X-ray tube (ground strap on the anode connector—see *Figure 4-199*).
3. Disconnect the high voltage connectors from the X-ray System (XRS) generator by inserting an Allen wrench into the hole on the side of the high voltage connector and turning the whole connector with the Allen wrench (there is no set screw in the hole). Remove as many cable ties as necessary.
4. Open the cooling hoses between cooling component E590 and the X-ray tube.

> NOTE:
>
> Dry the couplings with absorbent towels to ensure that cooling oil does not drip into the Gantry.

5. Remove the cover from the transport device of the new X-ray tube and place it over the cable duct between the Gantry and the Patient Table (shown in *Figure 4-200*). This cover is used as the transport frame for the old X-ray tube.

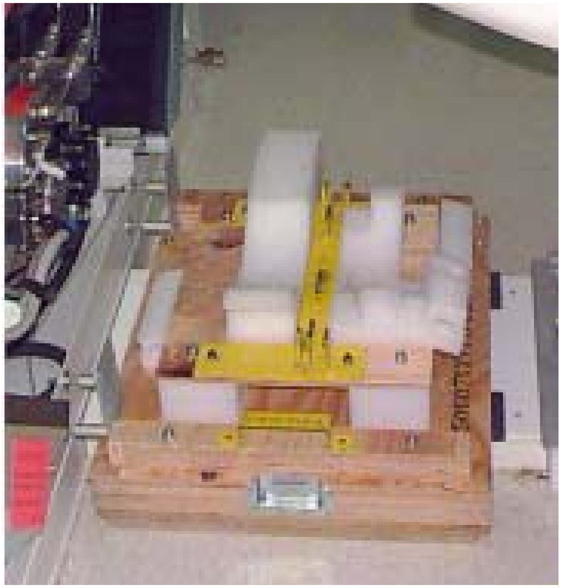


Figure 4-200: Transport Device

6. Attach the handle to the old X-ray tube (as shown in *Figure 4-201*) using the screws included with the new X-ray tube and a 6 mm Allen key.

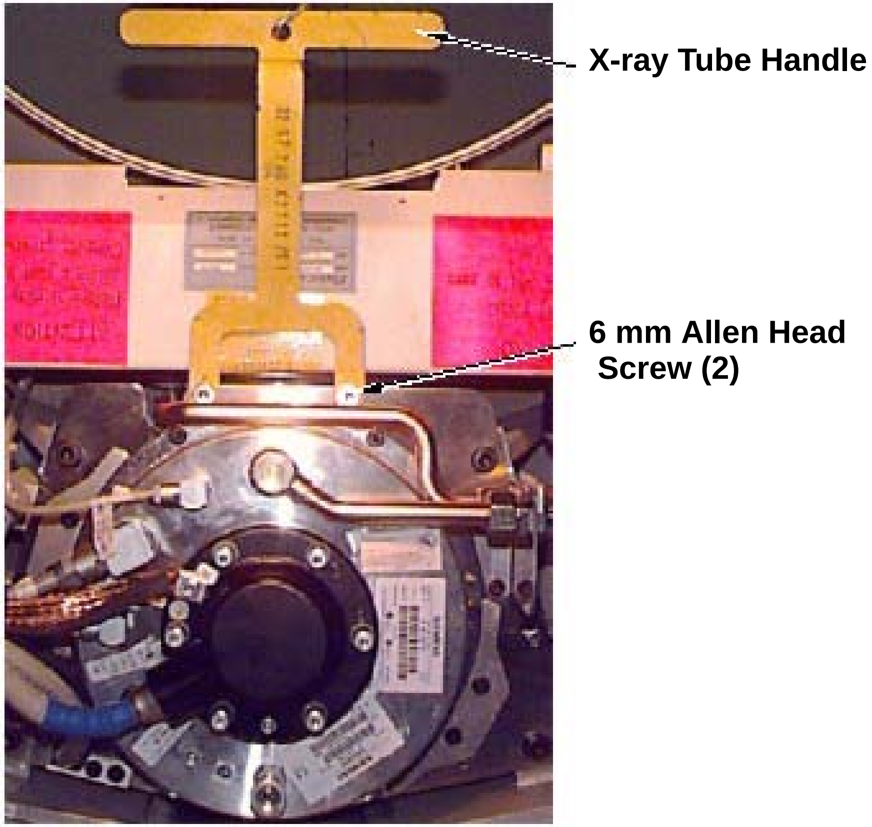

X-ray Tube Handle
6 mm Allen Head Screw (2)

Figure 4-201: X-ray Tube with Handle Attached

7. Place the pad on the Patient Table, at the end near the Gantry (shown in *Figure 4-202*).
8. With the table top support in its maximum innermost position, move the Patient Table Top into the patient aperture of the Gantry.
9. Secure the handle attached to the old tube to the Patient Table Top with the belt (see *Figure 4-202*).
10. Remove the four Allen bolts M10 (indicated in *Figure 4-199*).

NOTE:

Use the service switches on the right side under the table to adjust the height.

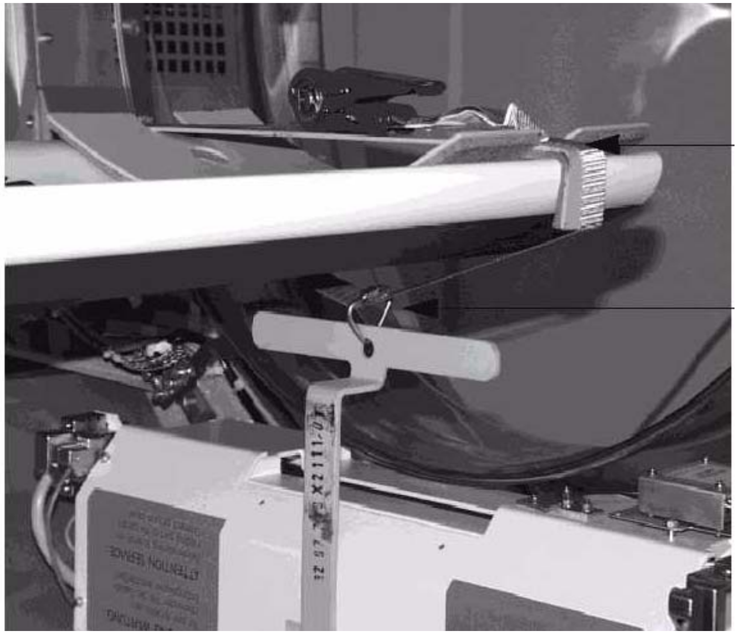


Figure 4-202: X-ray Tube Handle Attached to Top of Patient Table

11. Move the top of the Patient Table out of the tunnel of the Gantry until the X-ray tube hangs freely above the transport device.
12. Lower the Patient Table until the X-ray tube is lying in the transport device (see *Figure 4-203*).
13. Remove the belt from the Patient Table and secure the X-ray tube in the transport device.

NOTE:

Leave the handle attached to the old X-ray tube. Return them together.

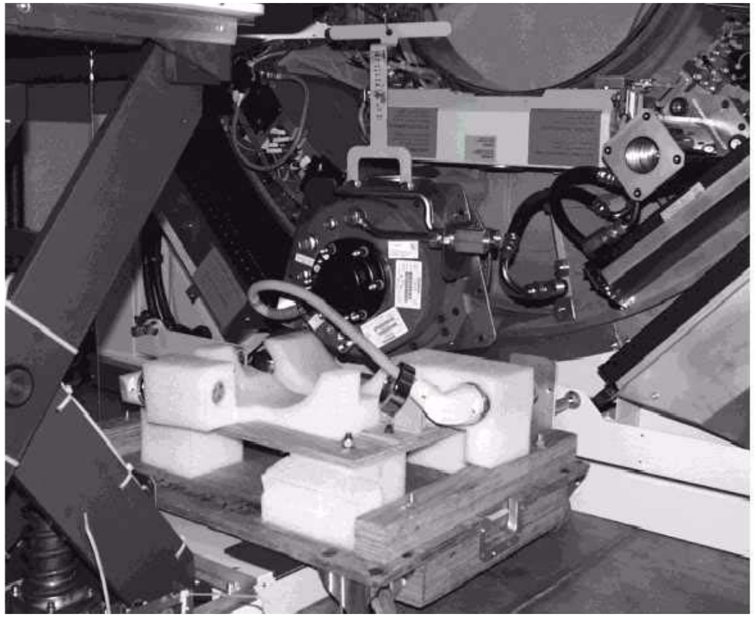


Figure 4-203: X-Ray Tube Above the Top of the Transport Device

Installing the New X-Ray Tube

Install the new X-ray tube as follows:

1. Position the new X-ray tube between the Gantry and the Patient Table.
2. Attach the handle on the new X-ray tube using the screws included with the new X-ray tube and a 6 mm Allen key as shown in *Figure 4-199*.
3. Lower the Patient Table until the belt attached to it touches the handle on the new X-ray tube (see *Figure 4-202*).

NOTE:

To adjust the height of the table, use the service switches under the table on the right.

4. With the tabletop support in its maximum innermost position, secure the handle of the new X-ray tube to the top of the Patient Table with the belt (see *Figure 4-203*).
5. Raise the table and carefully move the Patient Table Top into the Gantry patient aperture.
6. Using new screws and 90 Nm torque wrench, tighten the four Allen bolts M10 (indicated in *Figure 4-199*) in a cross pattern. to 80 Nm (59 ft/lbs).
7. Close the cooling hoses between cooling component E590 and the X-ray tube.
8. Remove the protective caps from the high voltage connectors, before connecting them.
9. Using new silicon washers, silicon rings and liquid silicon, install the high voltage connectors.
10. Connect the ground connection at the X-ray tube (ground strap on the anode (see *Figure 4-199*).
11. Connect the cable and connectors X4, X5 and X6 from the X-ray tube (see *Figure 4-199*).
12. Use cable ties and cable clamps to secure all cables and connectors.
13. Remove the belt from the Patient Table and remove the handle from the X-ray tube.

NOTE:

Adjust the membrane before removing the expansion vessel from the tube.

Tests and Adjustments

Adjust the expansion membrane of the cooling system for the X-ray tube as follows:

1. Read the current temperature of the X-ray tube oil as follows:
   a. Use CanPro to send the following command: **U-A0**
   b. Read the oil temperature from the line before the last in the FOC output.
2. Determine the correct membrane position from the graph shown in *Figure 4-204*.

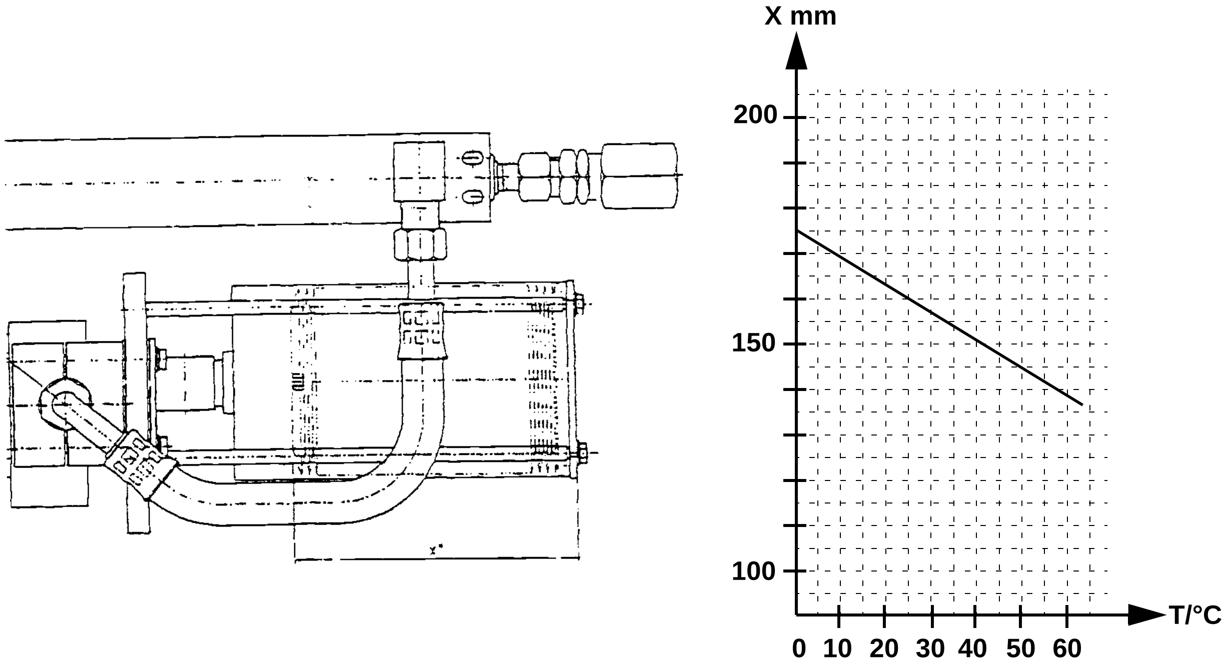


Figure 4-204: Membrane Adjustment

3. .Adjust the measurement device (included in the system tool kit) to the proper length according to the graph in *Figure 4-204* with the adjustment nut (see *Figure 4-206*).

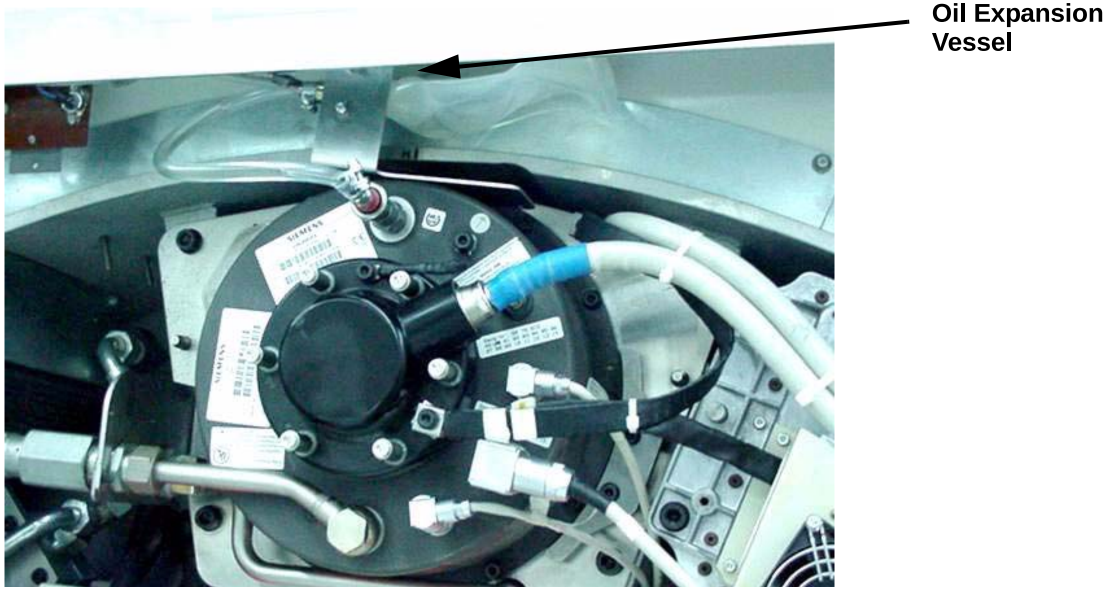

Oil Expansion Vessel

Figure 4-205: Oil Expansion Vessel

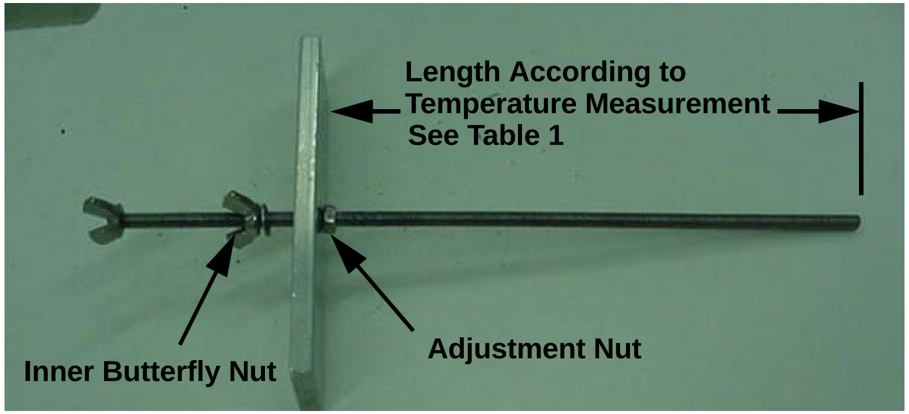

Length According to
Temperature Measurement
See Table 1
Inner Butterfly Nut
Adjustment Nut

Figure 4-206: Measurement Device

4. Screw the measurement device into the membrane unit. Tighten the inner butterfly nut so that the metal plate tightly fits to the membrane unit (see *Figure 4-207*). This brings the membrane to the correct position.

   Do not squeeze the oil expansion vessel. This can force air into the tube.

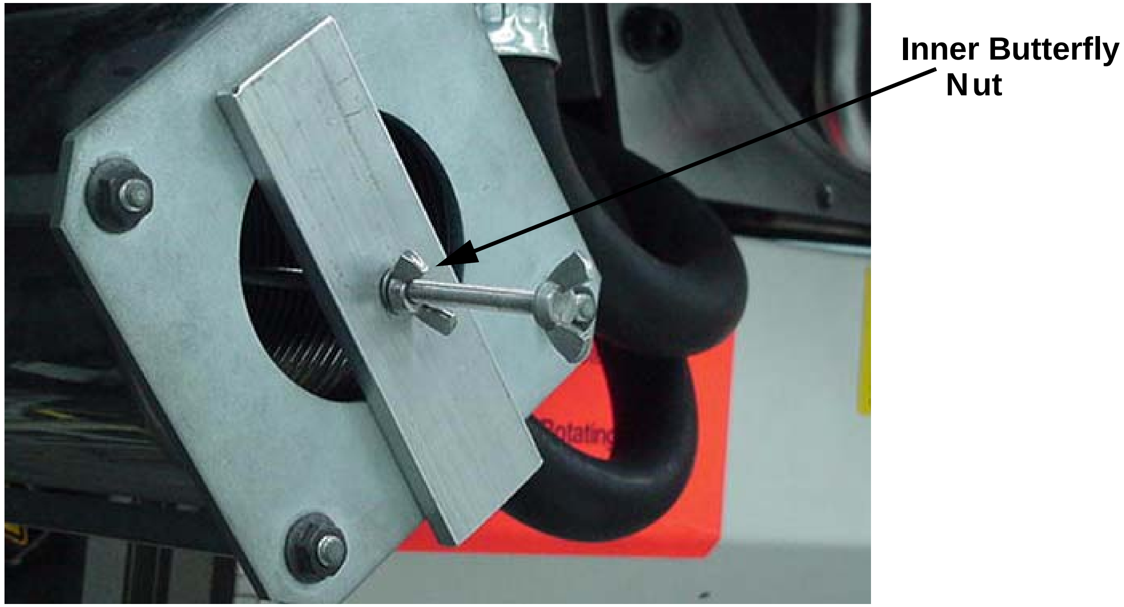


Figure 4-207: Positioning of the Measurement Device

5. When the position is correct, remove the expansion vessel from the valve on the tube. Be sure to remove the expansion vessel before removing the measurement device.

NOTE:

Return the expansion vessel together with the old X-ray tube.

Final Steps

Complete replacement of the X-ray tube by doing the following:

1. Set the S301 switch to the "1" position.
2. Release the safety locking pin.
3. Turn the S1 switch in the PDC to OFF.
4. Close the Gantry front cover.
5. Set the patient table S703 switch to the "0" position.
6. Turn ON the system from the CT Box.
7. Perform the Frequency Adaptation procedure (see *“Frequency Adaptation Calibration”*)
8. Perform a Long TC.
9. Perform a scan from the Host and verify the proper functioning of the system.

Replacing the E603 Electronic Box (E-Box)

Read these instructions completely before starting.

Use the tools and auxiliary materials recommended in these instructions.

Follow ESD guidelines, all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

CAUTION

AFTER YOU PERFORM THE E-BOX REPLACEMENT PROCEDURE, YOU MUST PERFORM ROTOR BALANCING (REFER TO *Gantry Rotor Balancing Procedure*, PMSTL P/N 491-7181-2009).

WARNING

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

Tools and Auxiliary Materials Required

- Standard FSE tool kit

The following tools and auxiliary materials are included in the packaging with the part:

- A strap with spanner
- One pad for the Patient Table
- Four new Allen screws
- A lifting device for the E-Box
- Cable ties

Preparations

Prepare to replace the E-Box as follows:

1. Move the patient table MAX down and MAX out.
2. Switch the Gantry OFF using the Gantry OFF switch on the CT Box.
3. In the PDC, turn the F1 and F9 switches OFF.
4. Open the front cover of the Gantry and set the S301 switch to the "0" position.
5. Position the electronic box at the 12 o’clock position and close the safety locking pin to prevent Gantry rotation.

WARNING

ELECTROCUTION HAZARD. HIGH A/C VOLTAGE IS EXPOSED IN MANY LOCATIONS AND 560 V DC IS PRESENT ON THE ROTOR SLIP RINGS. ALLOW 5 MINUTES FOR POWER TO BLEED OFF THE PDC CAPACITORS BEFORE

WORKING ON THE EQUIPMENT. THE CAPACITOR BANK IS DISCHARGED TO APPROXIMATELY 40VDC WHEN THE TWO LEDS ON D450 ARE OFF. FAILURE TO COMPLY WILL RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

6. Remove the lower front cover of the Gantry by releasing the six 10 mm nuts—Three on each side (see *Figure 4-208*).

> **NOTE:**
>
> Do not touch the other bolts. Any adjustments made to them misaligns the cover.

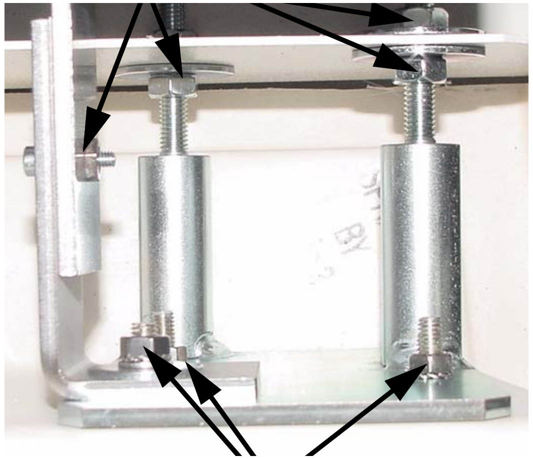


Figure 4-208: Gantry Front Cover Nuts

Removing the Old E-Box

Remove the old E-Box as follows:

1. Disconnect the following cables from the E-Box (see *Figure 4-209*):
   - — D440; X1,X2 (under white plastic cover)
   - — E603; X1,X2
   - — Ground Cable E603; X3
   - — D400; X3,X5

   Remove as many cable ties as necessary.

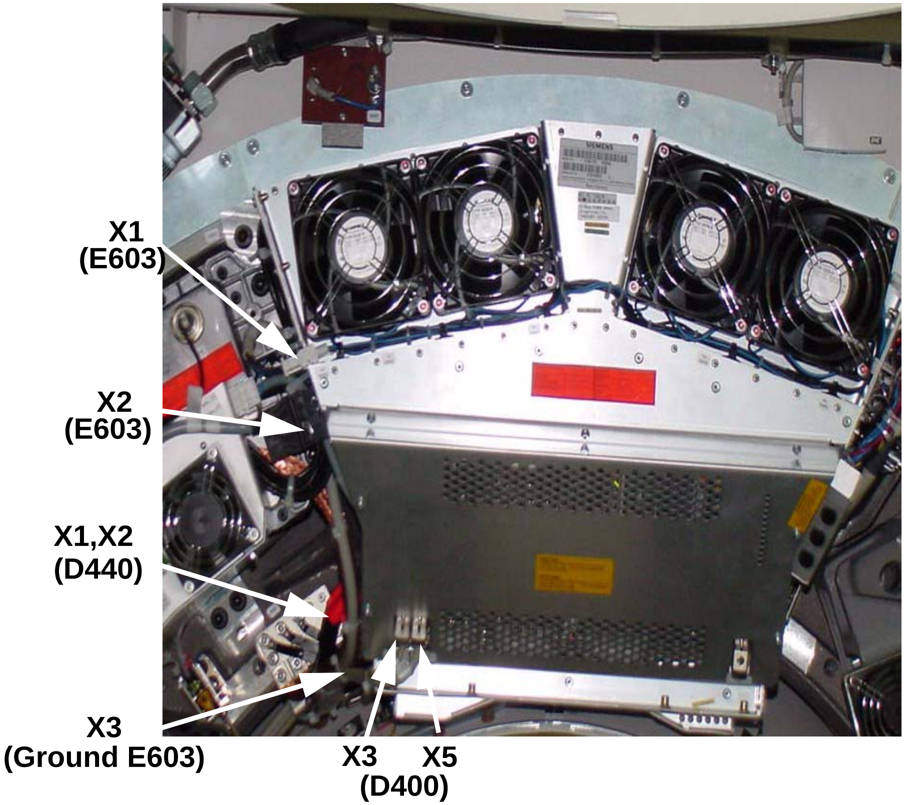

X1
(E603)
X2
(E603)
X1,X2
(D440)
X3
(Ground E603)
X3
X5
(D400)

Figure 4-209: Electronic Box Cables

2. Move the box to the 6 o’clock position.
3. Secure the rotating part of the Gantry with the locking pin.
4. Disconnect the following cables from the E604 HV Tank (see *Figure 4-210*):
   - — D432; X5,X6
   - — E604; X3
   - — D432; X1,X2,X3,X4

   Remove as many cable ties as necessary.

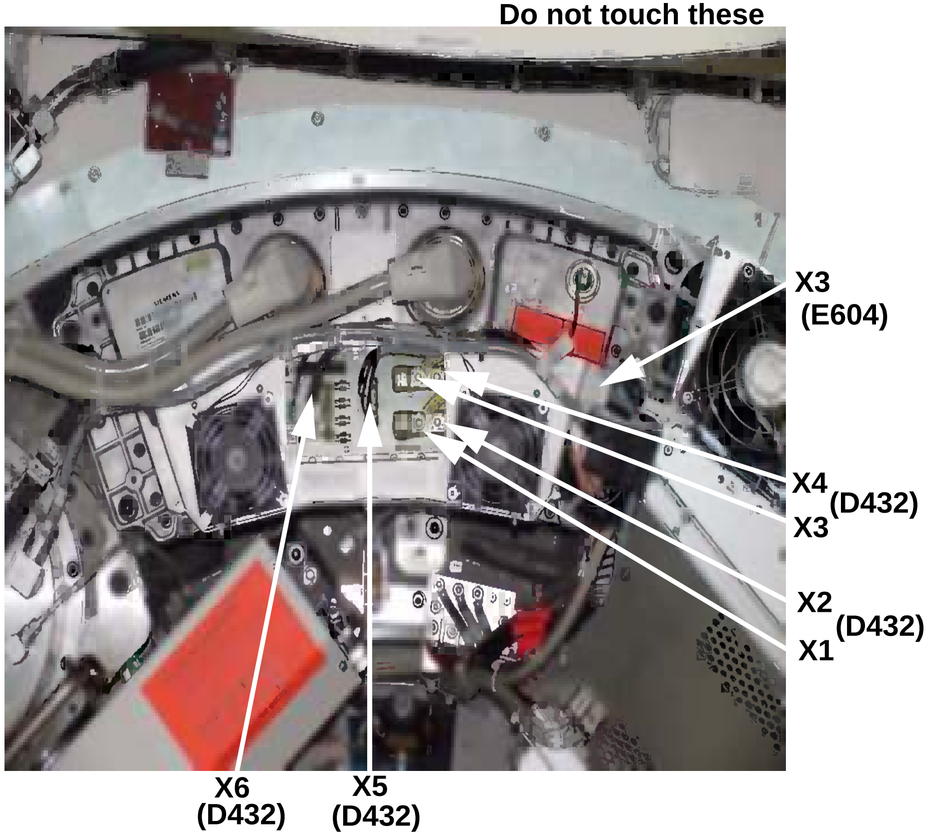

Do not touch these
X3
(E604)
X4
(D432)
X3
X2
(D432)
X1
X6
(D432)
X5
(D432)

Figure 4-210: HV Tank Cables

5. Remove the cover of the transport device and place it over the connection piece between the Gantry and the Patient Table.
6. Attach the lifting device that was included with the new E-Box to the old E-Box with four M6 Allen screws (see *Figure 4-211*).
7. In the PDC turn the F1 switch ON.
8. Turn switch S1 in the PDC to the ON position.

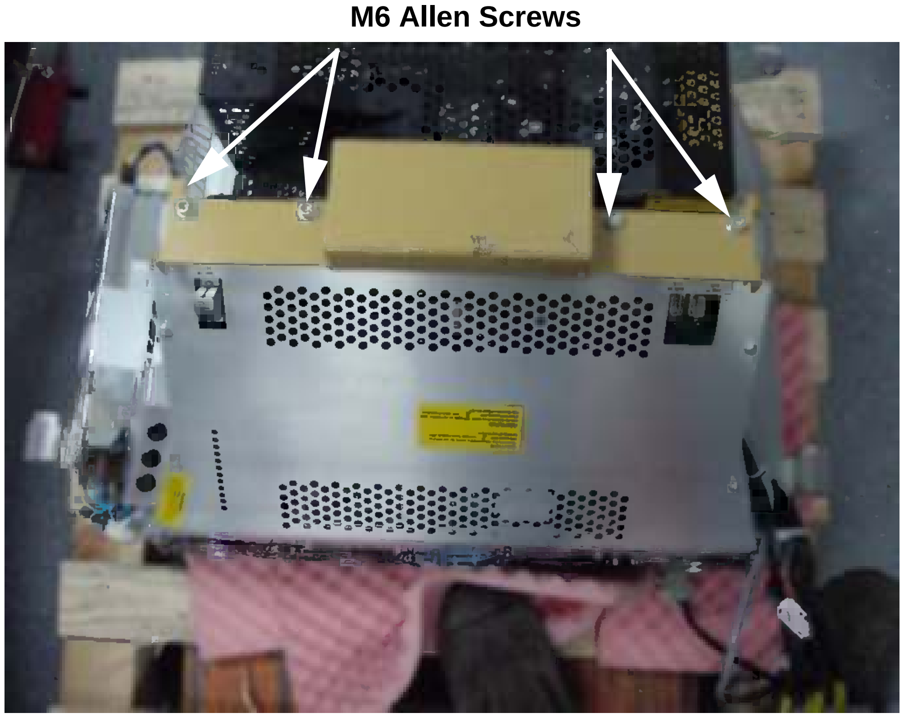


Figure 4-211: Attaching Lifting Device

WARNING

MECHANICAL HAZARD! THE NEXT STEP REQUIRES YOU TO SET THE SERVICE SWITCH S703 TO THE SERVICE POSITION. WITH SERVICE SWITCH S703 SET TO THE SERVICE POSITION, THERE IS NO UPPER AND LOWER HEIGHT LIMIT. THE SCISSORS CARRIAGE CAN BE DRIVEN INTO THE SUB-FRAME. EXERCISE EXTREME CAUTION WHEN RAISING OR LOWERING THE PATIENT TABLE WITH SERVICE SWITCH S703 IN THE SERVICE POSITION. FAILURE TO COMPLY CAN RESULT IN *SERIOUS INJURY OR DEATH* TO SERVICE PERSONNEL OR SERIOUS DAMAGE TO THE EQUIPMENT!

9. Remove the Patient Table sub-frame cover to expose the Patient Table service panel (see *Figure 4-212*.
10. Set Service Switch S703 to the Service Mode. Position 1 enables the Service Mode; position 0 disables Service Mode.
11. Raise the Patient Table to a high position with switch S701, leaving room for upward vertical motion required later in the procedure.
12. Put the pad on top of the Patient Table, at the end nearest to the Gantry.
13. Move the top of the Patient Table into the funnel of the Gantry.

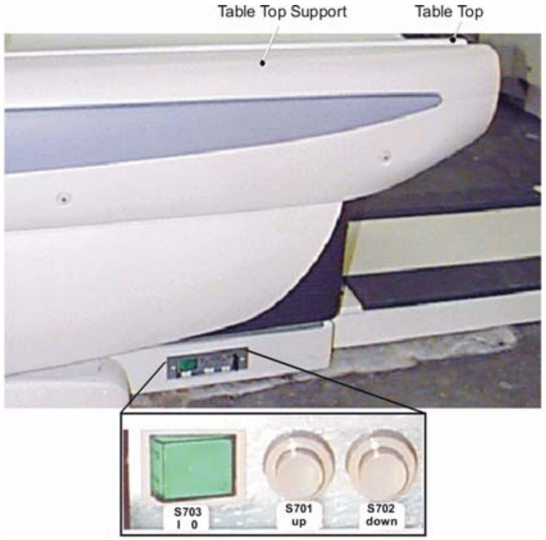


Figure 4-212: Patient Table Service Panel

14. Secure the E-Box lifting device to the pad on top of the Patient Table with the strap (see *Figure 4-213* and *Figure 4-214*).

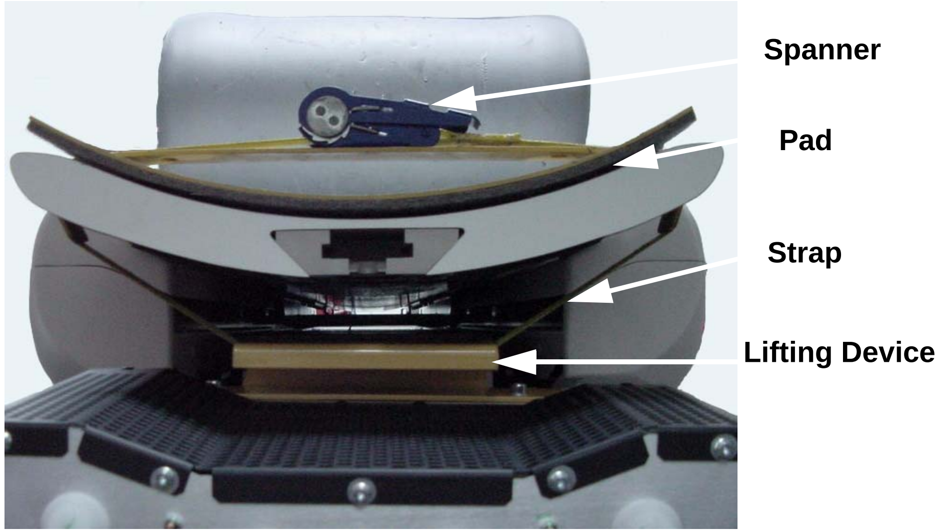

Spanner
Pad
Strap
Lifting Device

Figure 4-213: Securing the E-Box

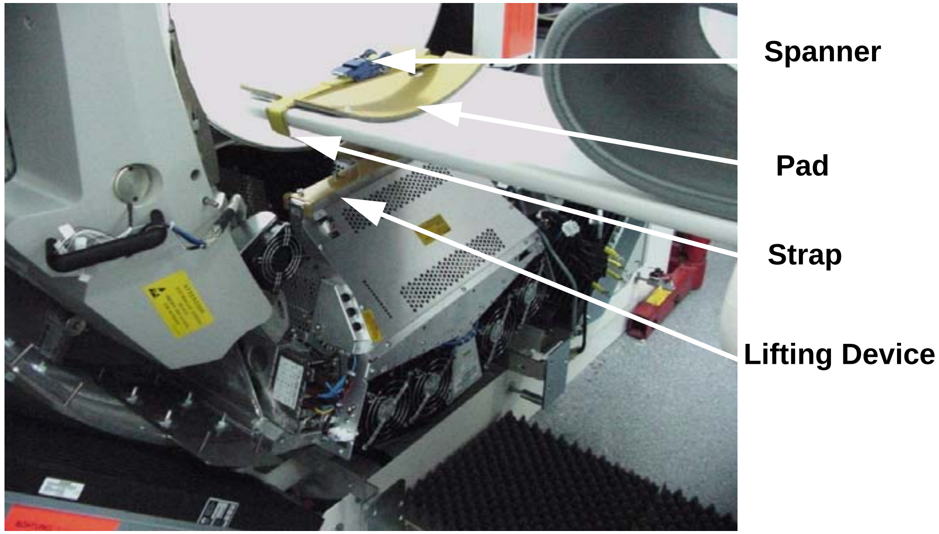

Spanner
Pad
Strap
Lifting Device

Figure 4-214: Lifting the E-Box

15. Remove the four M10 Allen screws securing the E-Box to the Gantry (see *Figure 4-215*) and dispose of the screws.

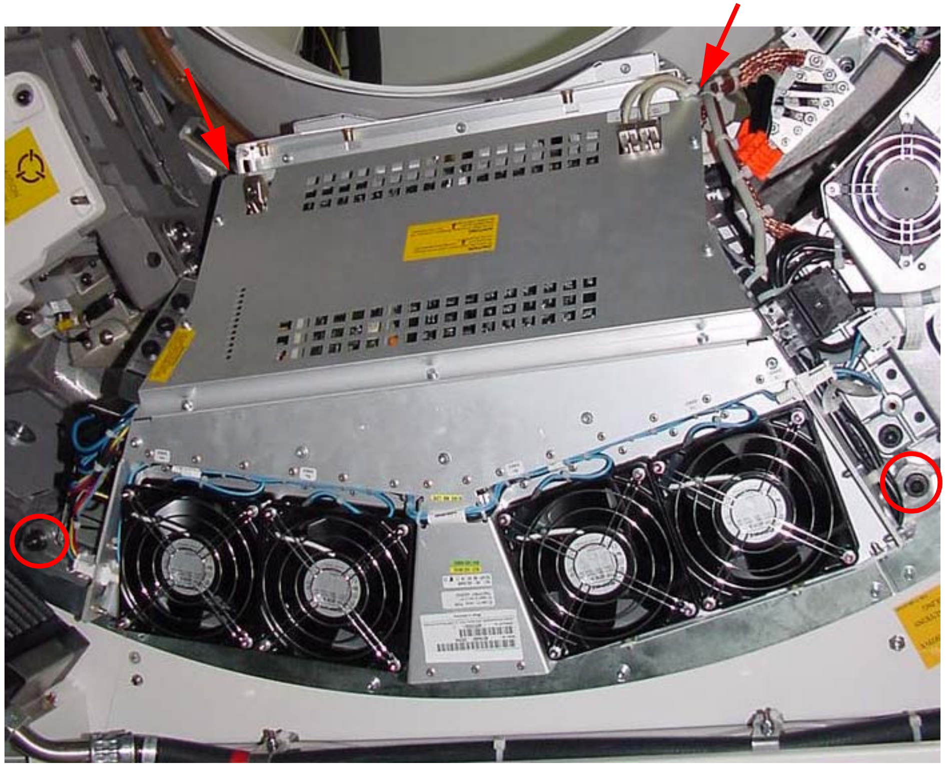


Figure 4-215: Four M10 Allen Screws Securing E-Box

NOTE:

Use the service switches on the right side under the Patient Table to adjust the height

16. Move the top of the Patient Table, with the E-Box on it, out of the funnel of the Gantry until the E-Box is between the Gantry and the Patient Table.
17. Lower the Patient Table until the E-Box rests on the transport device cover.

18. Secure the E-Box to the transport device (see *Figure 4-216*) with the screws provided.
19. Move the old E-Box of the generator out of the way.
20. Remove the lifting device from the old E-Box and attach the lifting device to the new E-Box.

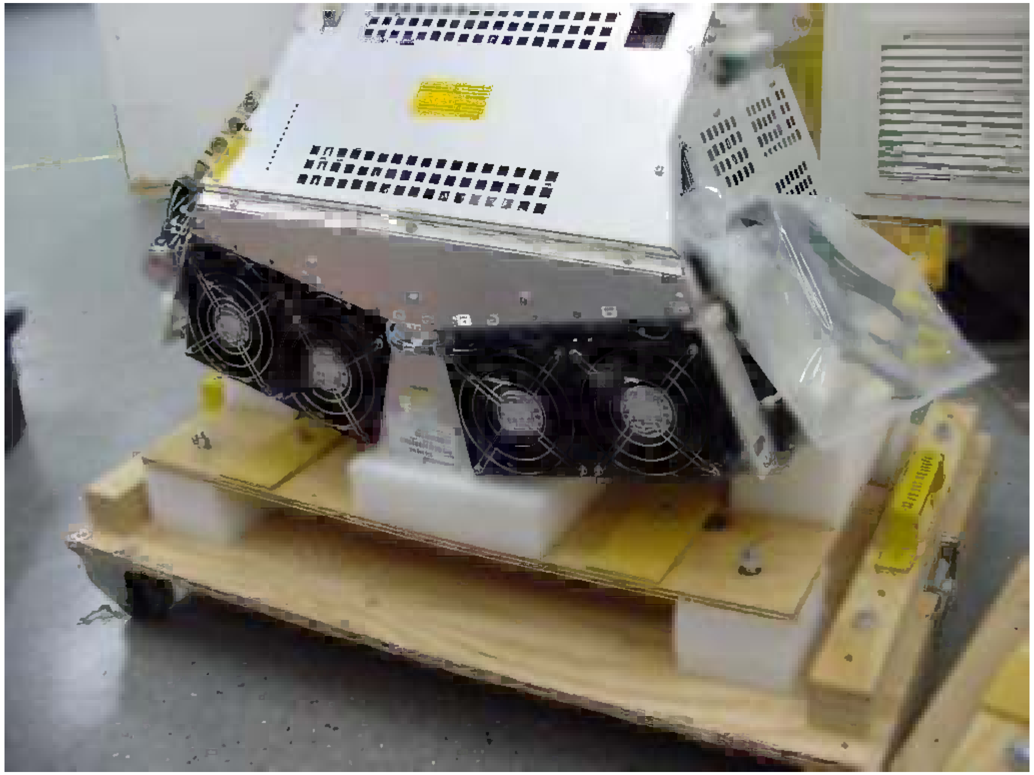


Figure 4-216: E-Box Transport Device

Installing the New E-Box

After removing the old E-Box, install the new one as follows:

1. Put the new E-Box (with the lifting device attached to it) on the transport device and move it between the Gantry and the Patient Table.
2. Remove the safety screws from the new E-Box.
3. Attach the lifting device and strap to the pad on the top of the Patient Table.
4. Raise the top of the Patient Table and move the Patient Table into the Gantry until the E-Box is in its correct position

⚠ **CAUTION**

WHEN MOVING THE PATIENT TABLE, BE CAREFUL NOT TO DAMAGE THE LEFT LIGHT MARKER.

5. Secure the new E-Box in place with the new set of four M10 Allen screws and tighten to a torque of 80 Nm.
6. Remove the lifting device from the new electronic box.

NOTE:

The pad, strap, and lifting device must be returned with the old electronic box.

7. Insert the Allen screws you removed earlier, during preparation.
8. Tighten
9. Tighten all screws with a torque wrench and a torque of 108 Nm.

10. Tighten D440, X1 X2 with a torque wrench and a torque of 4.8 Nm (see *Figure 4-217*).

NOTE:

Take care not to drop the screws while performing *Step 10*. If you drop the screws, the only way to get them out is to remove the E-Box again.

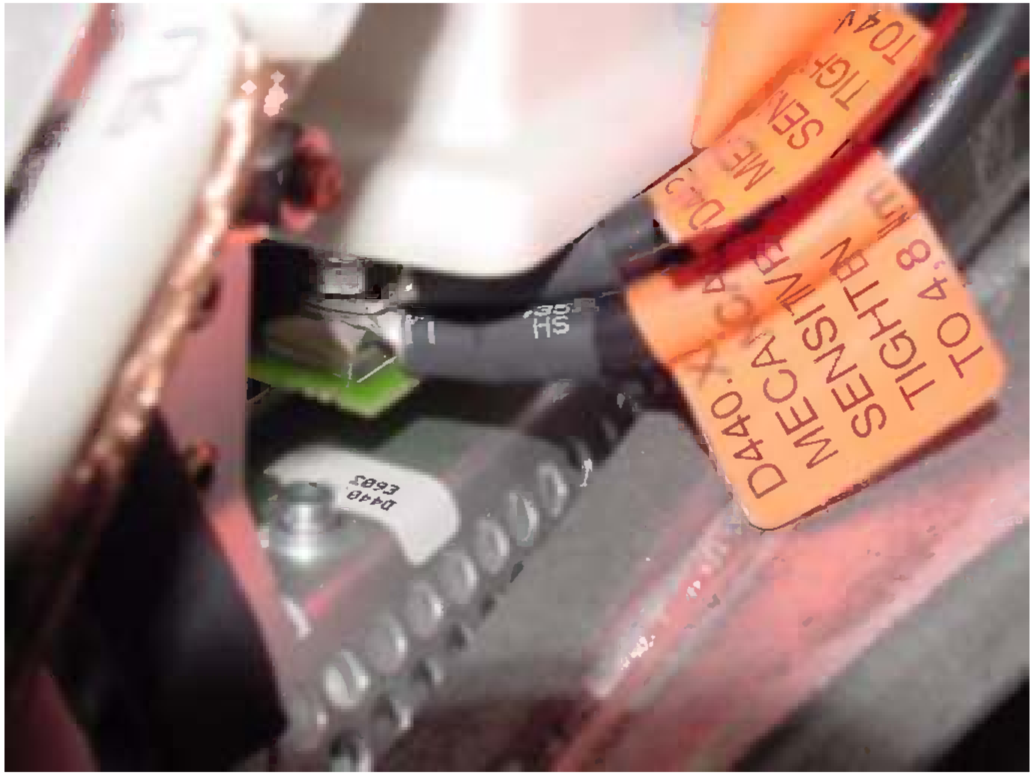

D440. X1 X2
MECANISME SENSIBLE
SENSITIVE MECHANISM
TIGHTEN TO 4.8 Nm
D440
E603

Figure 4-217: D440, X1 X2

Final Steps

Connect the cables that you disconnected at the beginning of the procedure and tighten to a torque of 4.8 Nm.

Tests and Adjustments

1. Set the S301 switch to the "1" position.
2. Release the safety locking pin.
3. Close Gantry front cover.
4. Turn the S1 switch in the PDC OFF.
5. Turn the F9 switch in the PDC ON.
6. Set the patient table S703 switch to the "0" position.
7. Turn ON the system from the CT-Box.
8. Perform the Frequency Adaptation procedure (see *“Frequency Adaptation Calibration”*).
9. Perform a scan from the Host and verify the proper functioning of the system.

Replacing the High Voltage (HV) Tank (E604)

Read these instructions completely before starting.

Use the tools and auxiliary materials recommended in these instructions.

Follow CMOS guidelines, all general safety guidelines and radiation protection ordinances (see *"Safety Guidelines"*).

⚠ **WARNING** ⚠

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

Tools and Auxiliary Materials Required

The following tools and auxiliary materials are included in the packaging with the part:

- A rope with a spanner
- One pad for the table top
- One set of new screws
- A lifting device for the electronic box of the generator.

Preparations

Prepare to replace the High Voltage (HV) Tank (E604) as follows:

1. Move the patient table MAX down and MAX out.
2. Open the front cover of the Gantry and set the S301 switch to the "0" position.
3. Position the HV Tank at the 12 o’clock position and close the safety locking pin to prevent Gantry rotation.
4. Switch the Gantry OFF using the Gantry OFF switch on the CT Box.

WARNING

ELECTROCUTION HAZARD. HIGH A/C VOLTAGE IS EXPOSED IN MANY LOCATIONS AND 560 V DC IS PRESENT ON THE ROTOR SLIP RINGS. ALLOW 5 MINUTES FOR POWER TO BLEED OFF THE PDC CAPACITORS BEFORE

WORKING ON THE EQUIPMENT. THE CAPACITOR BANK IS DISCHARGED TO APPROXIMATELY 40 V DC WHEN THE TWO LEDS ON D450 ARE OFF. FAILURE TO COMPLY WILL RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

5. Remove the lower front cover of the Gantry by releasing the six 10 mm nuts—Three on each side (see *Figure 4-218*).
6. Place switch S1 in the PDC to the ON position.

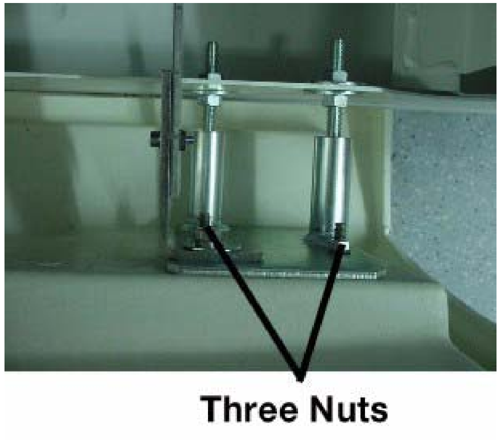


Figure 4-218:

WARNING

MECHANICAL HAZARD! THE NEXT STEP REQUIRES YOU TO SET THE SERVICE SWITCH S703 TO THE SERVICE POSITION. WITH SERVICE SWITCH S703 SET TO THE SERVICE POSITION, THERE IS NO UPPER AND LOWER HEIGHT LIMIT. THE SCISSORS CARRIAGE CAN BE DRIVEN INTO THE SUB-FRAME. EXERCISE EXTREME CAUTION WHEN RAISING OR LOWERING THE PATIENT TABLE WITH SERVICE SWITCH S703 IN THE SERVICE POSITION. FAILURE TO COMPLY CAN RESULT IN *SERIOUS INJURY OR DEATH* TO SERVICE PERSONNEL OR SERIOUS DAMAGE TO THE EQUIPMENT!

7. Remove the Patient Table sub-frame cover to expose the Patient Table service panel (see *Figure 4-219*.
8. Set Service Switch S703 to the Service Mode. Position 1 enables the Service Mode; position 0 disables Service Mode.
9. Raise the Patient Table to a high position with switch S701, leaving room for upward vertical motion required later in the procedure.

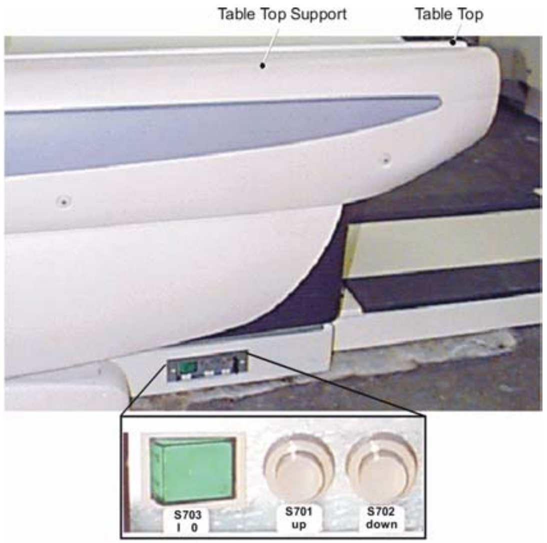


Figure 4-219: Patient Table Service Panel

Removing the Old Tank

Remove the old HV Tank as follows:

1. Disconnect the following cables from the E604 HV tank (see *Figure 4-220*):
   - Two HV cables to the x-ray tube
   - D432; X5,X6
   - D43; X1,X2,X3,X4
   - Ground cable to the x-ray tube
   - Ground Cable to the Gantry ground plate

   Remove as many cable ties as necessary.

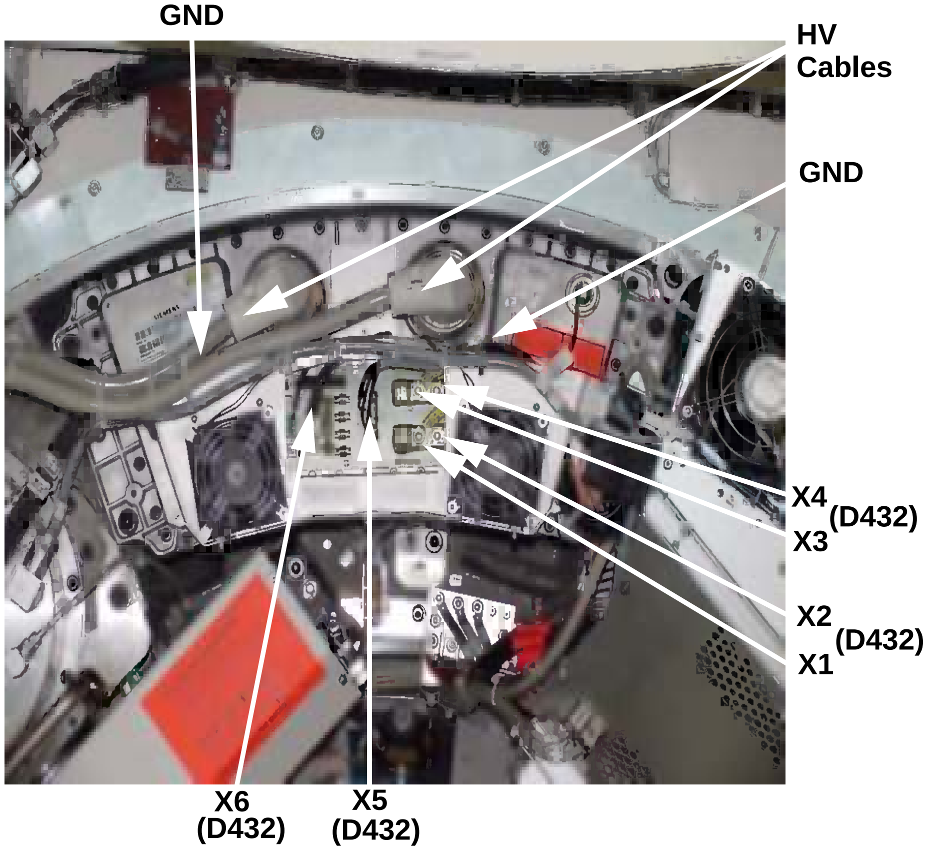


Figure 4-220: HV Tank Cables

2. Disconnect the following cable from the E603 electronic box (see *Figure 4-221*):

   — E603; X2

   Remove as many cable ties as necessary.

3. Move the HV tank to the 6 o'clock position.
4. Remove the Allen screws and remove the cover of the transport device. Put the cover over the cable duct between the Gantry and the Patient Table.

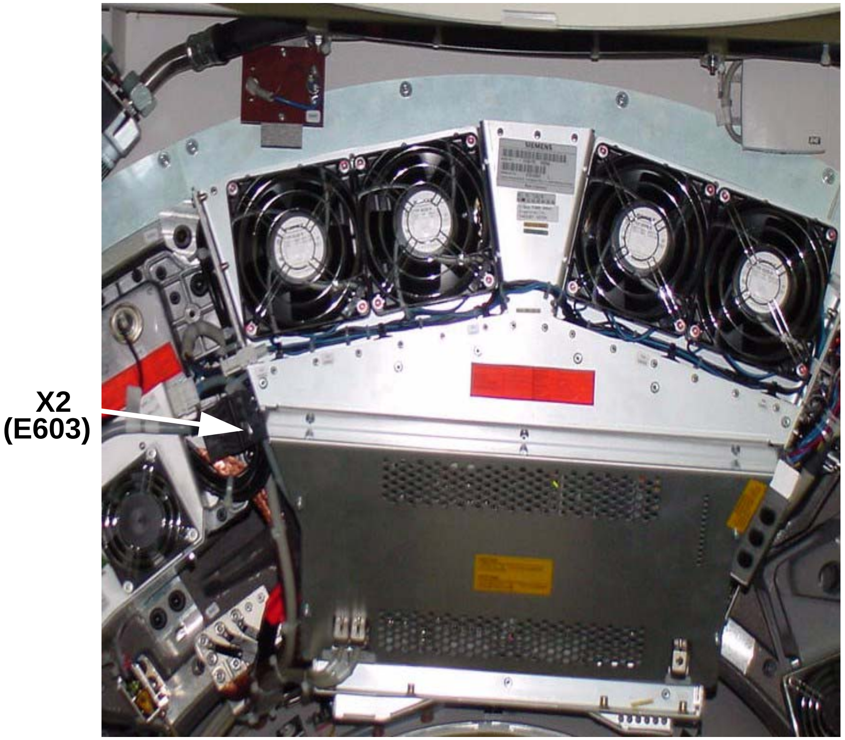


Figure 4-221: Electronic Box Cables

5. Attach the lifting device to the HV tank .
6. Switch ON the system using switch S1 inside the power distribution cabinet (PDC).
7. Put the pad on top of the Patient Table, at the end nearest to the Gantry.
8. Move the top of the Patient Table into the tunnel of the Gantry.
9. Secure the tank to the top of the Patient Table with the belt .

NOTE:

Use the service switches on the right side under the table to adjust the height.

10. Move the top of the Patient Table, with the HV tank on it, out of the tunnel of the Gantry until the transformer is between the Gantry and the Patient Table.
11. Lower the Patient Table until the tank rests on the transport device.
12. Secure the old tank to the transport device with the screws provided.
13. Move the old tank and the transport device out of the way.
14. Remove the lifting device from the old transformer and attach the lifting device to the new tank.

Installing the New Tank

After removing the old HV tank, install the new one as follows:

1. Put the new tank (with the lifting device attached to it) on the transport device and move it between the Gantry and the Patient Table.
2. Remove the safety screws from the new electronic box.
3. Attach the lifting device and belt to the pad on the top of the Patient Table.
4. Raise the top of the Patient Table and move the Patient Table into the Gantry until the new tank is in its correct position.

⚠ CAUTION

WHEN YOU MOVE THE TABLE TOP, BE CAREFUL NOT TO DAMAGE THE LEFT LIGHT MARKER.

5. Secure the new tank in place with the new set of screws.
6. Remove the lifting device from the new tank.

NOTE:

The handle must be returned with the old tank.

7. Insert the Allen screws you removed earlier, during preparation.
8. Tighten all screws with a torque wrench and a torque of 108 Nm.

Final Steps

Connect the cables that you disconnected at the beginning of the procedure.

Tests and Adjustments

1. Set the S301 switch to the "1" position.
2. Release the safety locking pin.
3. Turn the S1 switch in the PDC to OFF.
4. Close the Gantry front cover.
5. Set the patient table S703 switch to the "0" position.
6. Turn ON the system from the CT Box.
7. Perform the Frequency Adaptation procedure (see *“Frequency Adaptation Calibration”*)
8. Perform a scan from the Host and verify the proper functioning of the system.

Replacing the Main Control Board (D400)

Read these instructions completely before starting.

Follow CMOS guidelines, all general safety guidelines and radiation protection ordinances (see *"Safety Guidelines"*).

WARNING

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

Tools and Auxiliary Materials Required

No special tools are required for this procedure.

Preparations

Prepare to replace the Main Control Board (D400) as follows:

1. Move the patient table MAX down and MAX out.
2. Open the front cover of the Gantry and set the S301 switch to the "0" position.
3. Position the electronic box at the 3 o'clock position and close the safety locking pin to prevent Gantry rotation.
4. Switch the Gantry OFF using the Gantry OFF switch on the CT Box.

WARNING

ELECTROCUTION HAZARD. HIGH A/C VOLTAGE IS EXPOSED IN MANY LOCATIONS AND 560 V DC IS PRESENT ON THE ROTOR SLIP RINGS. ALLOW 5 MINUTES FOR POWER TO BLEED OFF THE PDC CAPACITORS BEFORE

WORKING ON THE EQUIPMENT. THE CAPACITOR BANK IS DISCHARGED TO APPROXIMATELY 40 V DC WHEN THE TWO LEDS ON D450 ARE OFF. FAILURE TO COMPLY WILL RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

Removing the Old Main Control Board

Remove the old Main Control Board as follows:

1. Disconnect the D400 (**Gen.rot**) cable from connectors X3 and X5.
2. Using a 3 mm Allen wrench, remove the ten screws that secure the cover of the electronic box and remove the cover (see *Figure 4-222*).

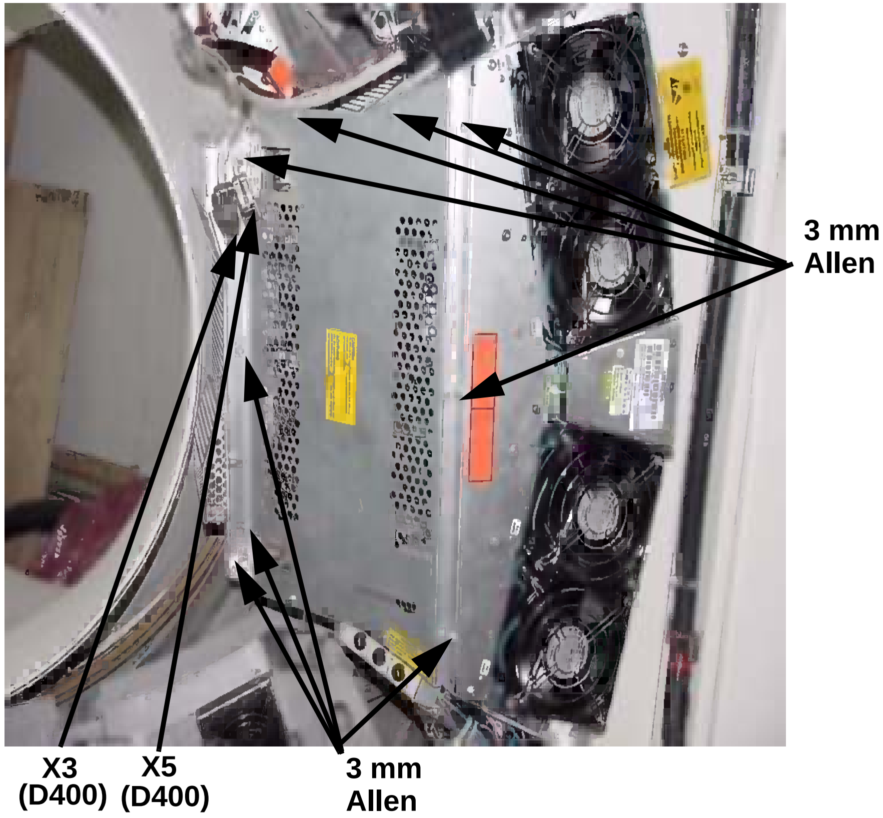


Figure 4-222: Electronic Box Cover Screws

3. Disconnect the cables from the following connectors on the Main Control Board (see *Figure 4-223*):
   - — X12
   - — X13
   - — X6
   - — X1
   - — X15
   - — X7
   - — X8
   - — X9
4. Remove the six white plastic screws that hold the board in place and remove the board.

NOTE:

Be careful not to damage the cables when you remove the board.

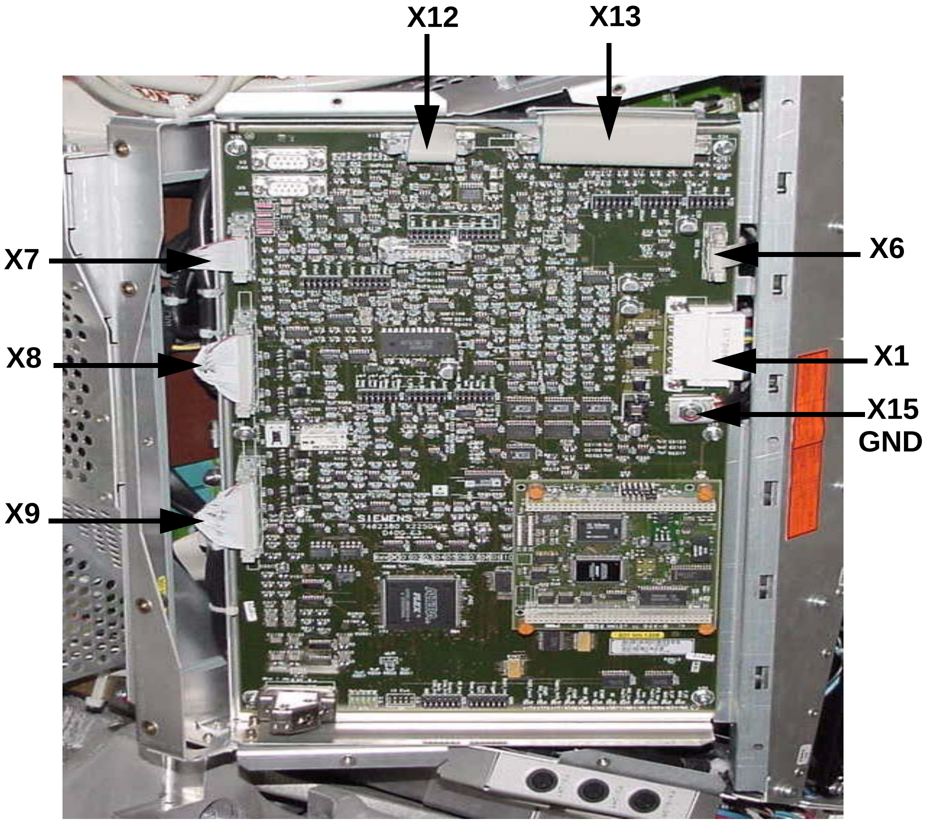


Figure 4-223: Main Control Board (D400) Connectors

Installing the New Main Control Board

After removing the old main control board, install the new one as follows:

1. Remove MCB from the old control board and install it in the new board.
2. Insert the new main control board.
3. Connect all the cables you disconnected in the previous section. Listen for the audible click that indicates each plug is correctly locked into place.
4. Tighten the ground cable to a torque of 4.8 Nm.
5. Secure the board with the six white plastic screws.
6. Attach the metal cover to the electronic box.
7. Tighten all ten screws with a torque wrench and a torque of 3 Nm.
8. Connect the cables at connectors X3 and X5.
9. Secure all cables with cable ties.

Final Steps

Remove the "Who I am" (D400-X4) plug from the old control board and attach it to the board.

Tests and Adjustments

1. Set the S301 switch to the "1" position.
2. Release the safety locking pin.
3. Turn the S1 switch in the PDC to OFF.
4. Close the Gantry front cover.
5. Turn ON the system from the CT Box.
6. Perform the Frequency Adaptation procedure (see *“Frequency Adaptation Calibration”*)
7. Perform a scan from the Host and verify the proper functioning of the system.

Replacing the Fil (D470)/RAC (D115) Assembly

This procedure describes how to replace the assembly that contains the Filament Power Board (D470) and the Rotating Anode Control Board ((D115).

Read these instructions completely before starting.

Use the tools and auxiliary materials recommended in these instructions.

Follow ESD guidelines, all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

Tools and Auxiliary Materials Required

- 3 mm Allen key
- Small flat head screwdriver
- Wire cutter
- Long nosed pliers
- 6 mm hex ratchet

- Flashlight
- ESD antistatic wrist strap

Estimated Time

The estimated time for this procedure is three hours.

Preparations

Prepare to replace the FIL/RAC assembly as follows:

1. Move the patient table MAX down and MAX out.
2. Switch the Gantry OFF using the Gantry OFF switch on the CT Box.
3. In the PDC, turn the F1 and F9 switches OFF. Turn OFF the UPS.
4. Open the front cover of the Gantry and set the S301 switch to the "0" position.
5. Position the electronic box approximately at the 11 o’clock position and lock the security pin to prevent Gantry rotation.

⚠ WARNING

ELECTROCUTION HAZARD. HIGH A/C VOLTAGE IS EXPOSED IN MANY LOCATIONS AND 560 V DC IS PRESENT ON THE ROTOR SLIP RINGS. ALLOW 5 MINUTES FOR POWER TO BLEED OFF THE PDC CAPACITORS BEFORE

WORKING ON THE EQUIPMENT. THE CAPACITOR BANK IS DISCHARGED TO APPROXIMATELY 40 V DC WHEN THE TWO LEDS ON D450 ARE OFF. FAILURE TO COMPLY WILL RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

Removing the Old FIL/RAC Assembly

Remove the old Fil/RAC Assembly as follows:

1. Open the screws on connectors X3 and X5 and remove the cables (see *Figure 4-224*).
2. Using a 3 mm Allen wrench, remove the ten screws that secure the cover of the electronic box and remove the cover (see *Figure 4-225*).

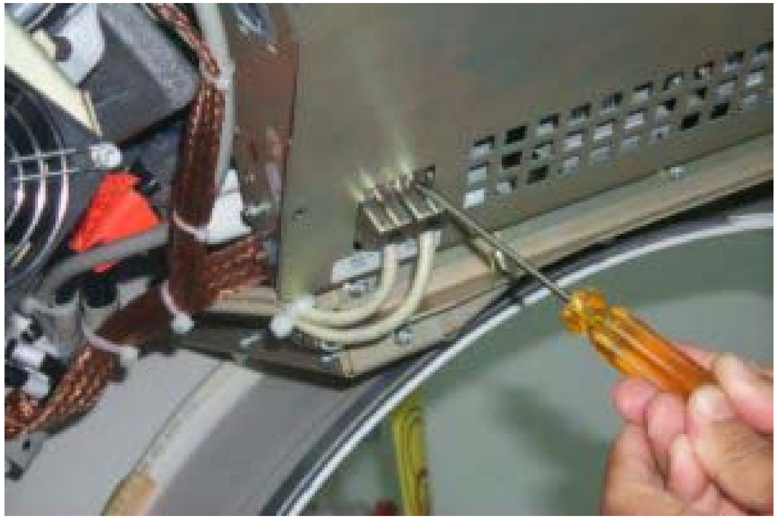


Figure 4-224: Connectors X3 and X5 Detail

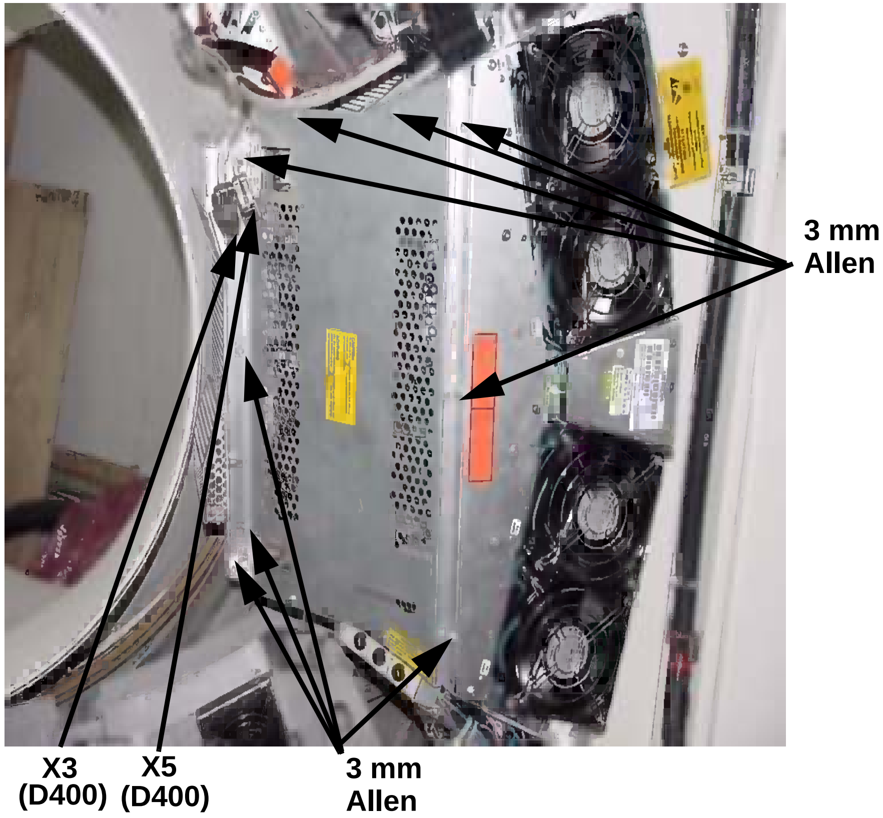


Figure 4-225: Electronic Box Cover Screws

3. Pull down the D400 card base (see *Figure 4-226*).

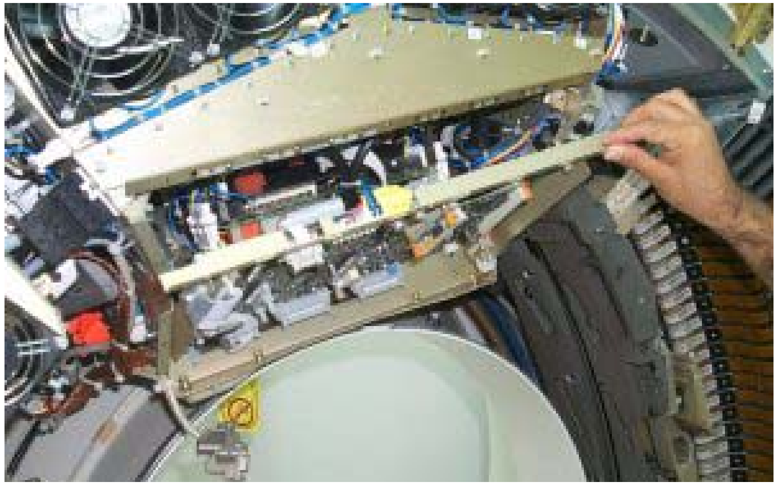


Figure 4-226: Main Control Board (D400)

4. Disconnect the six plugs on the Fil/RAC card (see *Figure 4-227*).

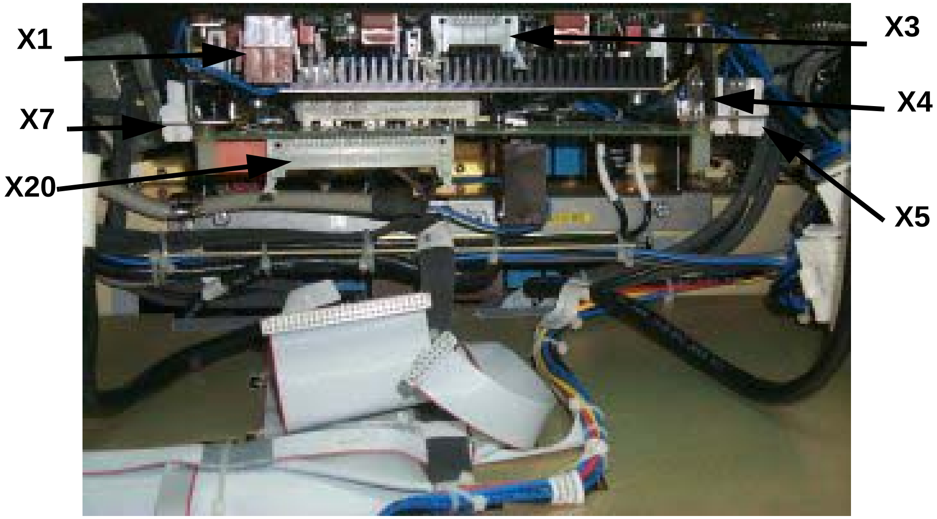


Figure 4-227: Fil/RAC Card Plugs

5. Use wire cutters to cut cable ties from cables W606 and W607 (see *Figure 4-228*)

NOTE:

If the wires are not marked, tag each wire to facilitate reconnecting.

6. Use long-nosed pliers to release wires X5, X6, X7, X8, and X9. Verify the connector number on each wire.
7. Pull wire number X7 out through the brown component (the current measurement coil) (see *Figure 4-229*).

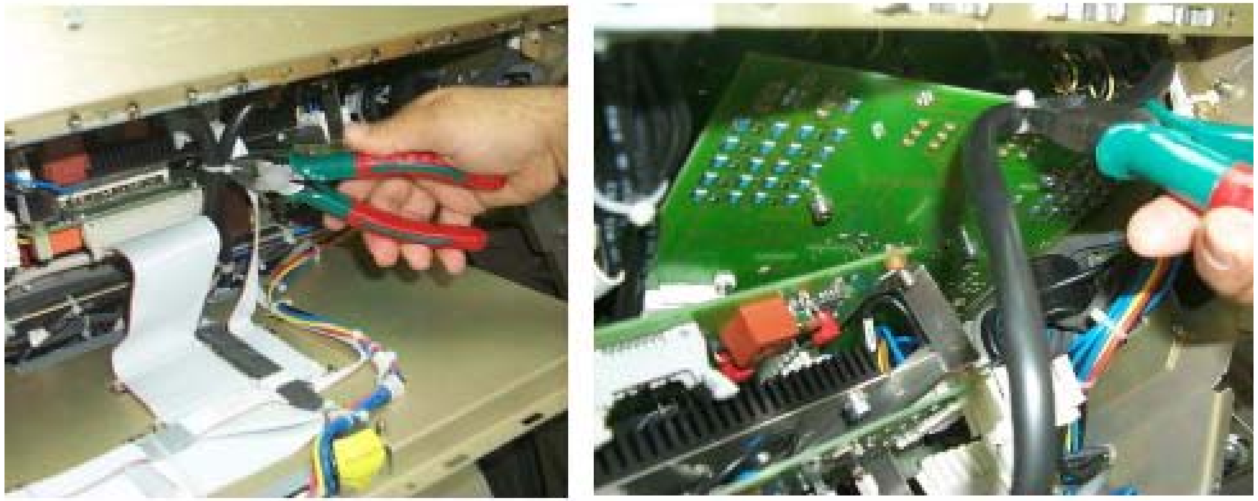


Figure 4-228: Cutting Cable Ties from W606 and W607

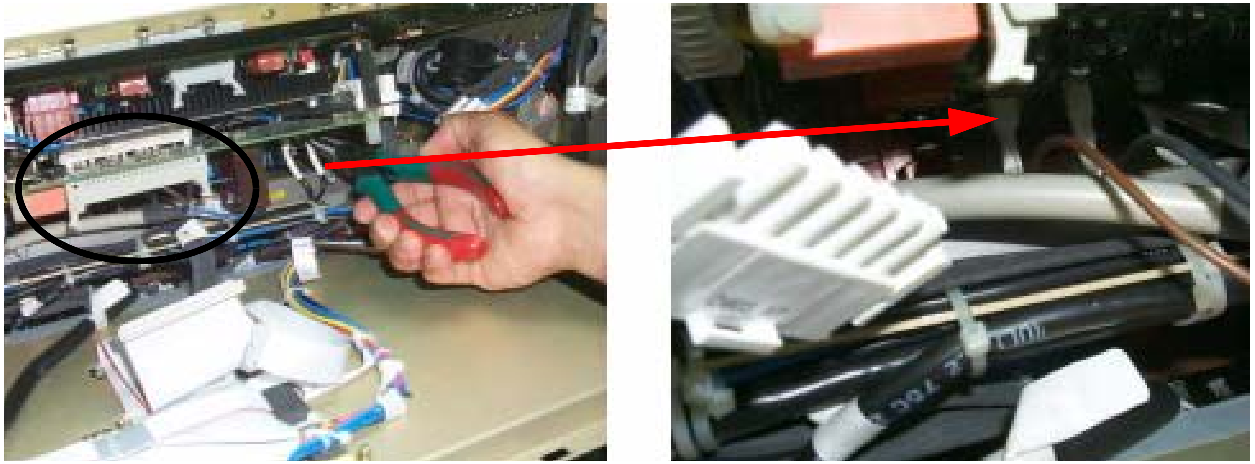


Figure 4-229: Removal of X7

8. Cut the cable ties and release wire number W610 (see *Figure 4-230*).
9. Use a 6 mm hex ratchet to open the nut from the cable retainer on W622 (see *Figure 4-231*).

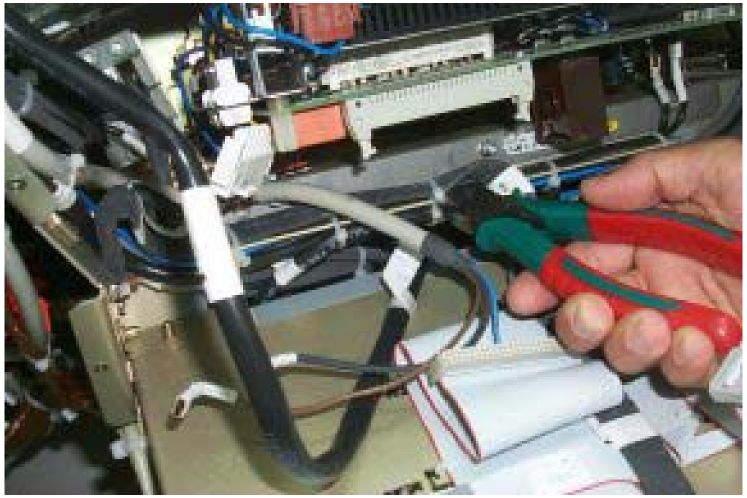


Figure 4-230: Wire W610

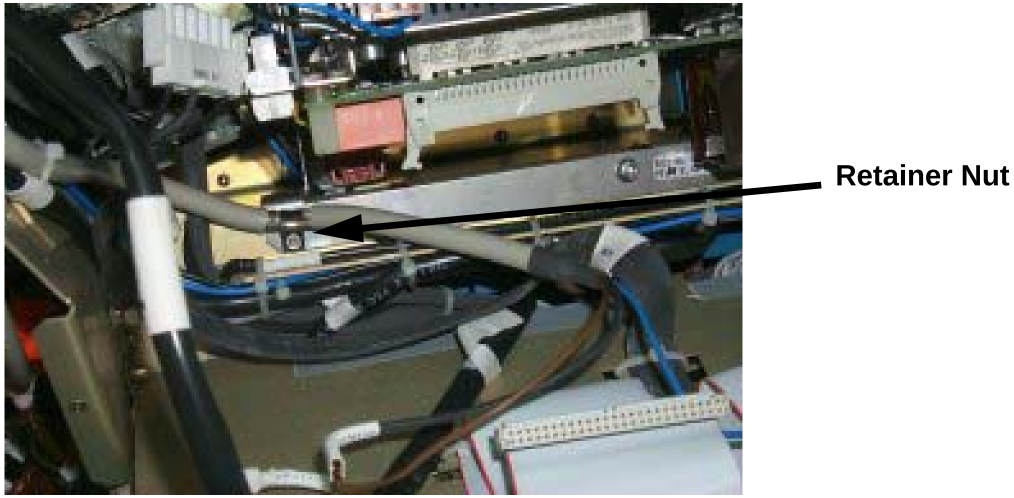


Figure 4-231: Cable W622 and Retainer Nut

10. Open the three Allen screws at the bottom of the card, and remove the card (see *Figure 4-232*).

NOTE:

Make sure that the card is free from all cables before you remove the card.

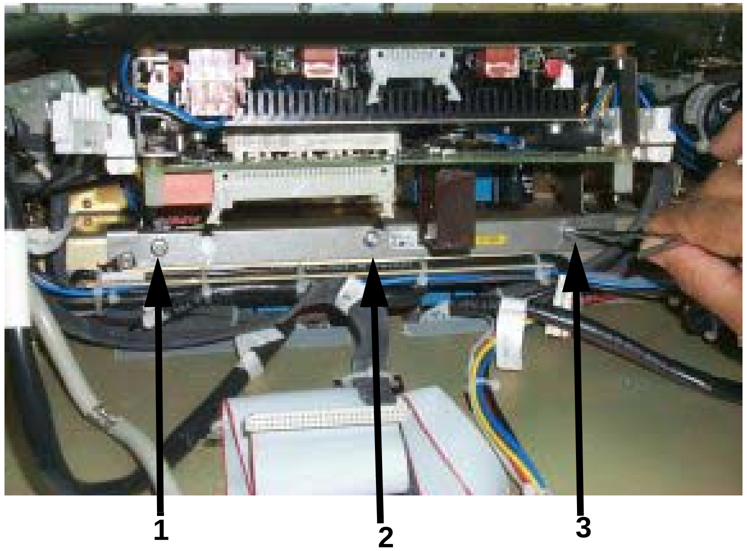


Figure 4-232: Allen Screws on the Bottom of the Card

Fil/RAC Installation

1. Insert the new card. With the card inserted approximately halfway, insert connectors numbered X5, X6, X7, X8, and X9.
2. Continue to insert the card until it is properly in place and aligned on the two inside pins (see *Figure 4-233*).
3. Insert and close the three Allen screws.
4. Close the cable retainer nut that holds cable W622 in place.
5. Close the Fil/RAC connectors X1, X4, and X5. Pull the X7 wire through, the current measurement coil.
6. Use cable ties to secure W606 and W607 (together) to the upper base.
7. Close the flat connectors X3 and X5.
8. Pull the D400 card base up.
9. Replace and close the E-Box cover with the three Allen screws.

10. Close connectors X3 and X5.

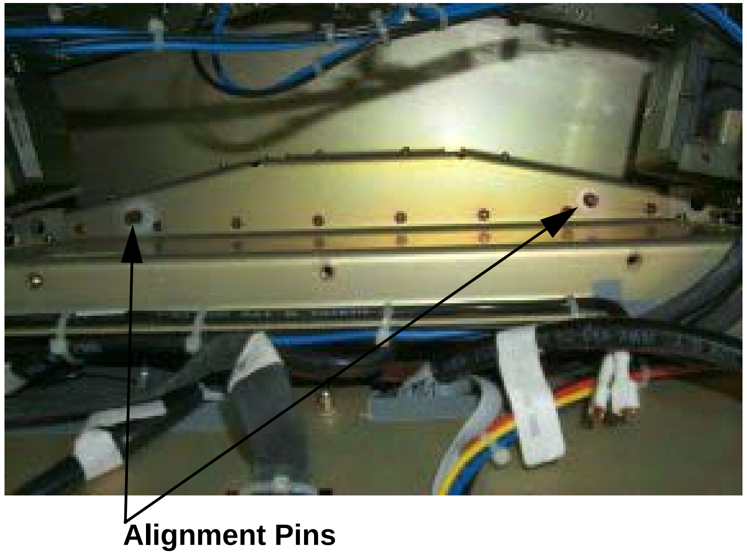


Figure 4-233: Alignment Pins

Final Steps

1. Unlock the security pin.
2. Close all system covers.
3. Turn the system on.
4. Perform several Axial, Surview, and Helix scans.
5. Verify proper operation of the system.

Replacing the X-Ray Tube Heat Exchanger

Overview

The purpose of the section is to instruct the FSE on the proper replacement procedure of the Mx8000 x-ray tube's heat exchanger, pump, and bellows assembly. This assembly, P/N /SP714806159, is stocked as one unit. The heat exchangers, oil pumps, and bellows are not stocked separately.

The reasons for x-ray tube heat exchanger, pump, and bellows replacement can be found in Technical Note CT 2908-028 Tube Cooling Membrane Inspection.

Read the entire procedure before beginning.

Before disconnecting or removing any parts, note their configuration so you are able to connect or install replacement parts correctly.

Follow all general safety guidelines and radiation protection ordinances (see *"Safety Guidelines"*).

Tools

- FSE tool-kit
- 17mm socket wrench with extension
- 17mm crescent wrench
- 36mm crescent wrench
- Silicone RTV (purchased locally)

NOTE:

The following procedure requires two people. The x-ray tube heat exchanger, pump, and bellows assembly is bulky and weighs about 18 kg. (40 lbs.).

Procedure

Removal of the Old Assembly

The new heat exchanger assembly does not contain the aluminum frame. The removal procedure requires disassembly of the heat exchanger with the aluminum frame, replacement of the heat exchanger and installation of the new heat exchanger with the original aluminum frame.

1. Move the bed Max DOWN and Max OUT.
2. Logout of the system application software, select **Shutdown** and then power down the system from the console.

WARNING

ELECTRICAL HAZARD! TURN THE SYSTEM OFF COMPLETELY AT THE WALL BOX.

3. Remove the Plexiglas ring and open the front cover.
4. Remove the rear cover.
5. Rotate the Gantry rotor until the tube is at the 3 o'clock position and lock it in place with the locking pin located at 1 o'clock, as viewed from the front of the Gantry.
6. Locate the cable labeled E535 X2 that runs from the pump motor and remove it at its connector (see *Figure 4-234*).
7. Disconnect the two oil lines (see *Figure 4-234*) that connect to the x-ray tube with a 36 mm crescent wrench. There is no oil leakage due to the one-way valve.

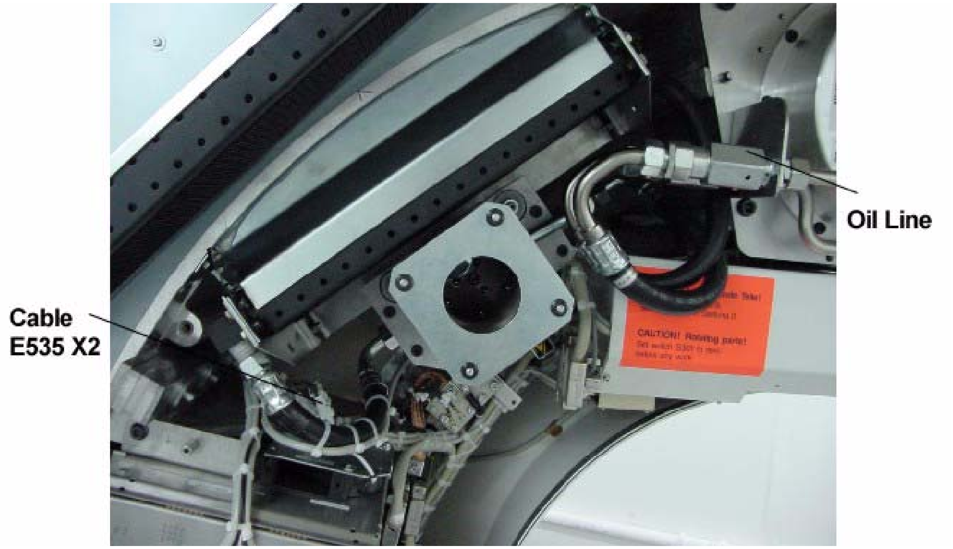


Figure 4-234: Oil Line and Electrical Label

WARNING

TO ACCESS EACH OF THE TWO 5 MM SCREWS FROM THE REAR OF THE GANTRY, IT IS NECESSARY TO UNLOCK AND RE-POSITION THE ROTOR. USE EXTREME CAUTION WHEN DOING SO.

- **MAKE SURE THAT ONE PERSON HOLDS THE ROTOR STATIONARY WHILE REMOVING THE SCREWS.**
- **LOCK THE ROTOR IN THE 3 O'CLOCK POSITION AFTER YOU HAVE REMOVED BOTH SCREWS.**

8. Locate the four 5 mm Allen screws that secure the heat exchanger on the outside circumference of the rotor. Access two of the 5 mm Allen screws from the front of the Gantry and the other from the rear of the Gantry (see *Figure 4-235* and *Figure 4-236*).
   Remove all four screws with a 5 mm Allen key.

The 11mm nuts on the heat exchanger that are attached to the 5mm Allen screws are part of the heat exchanger frame and do not turn.

The heat exchanger does not detach by removing just these four screws. It is also secured by two 17 mm hex nuts that are removed in *Step 13*.

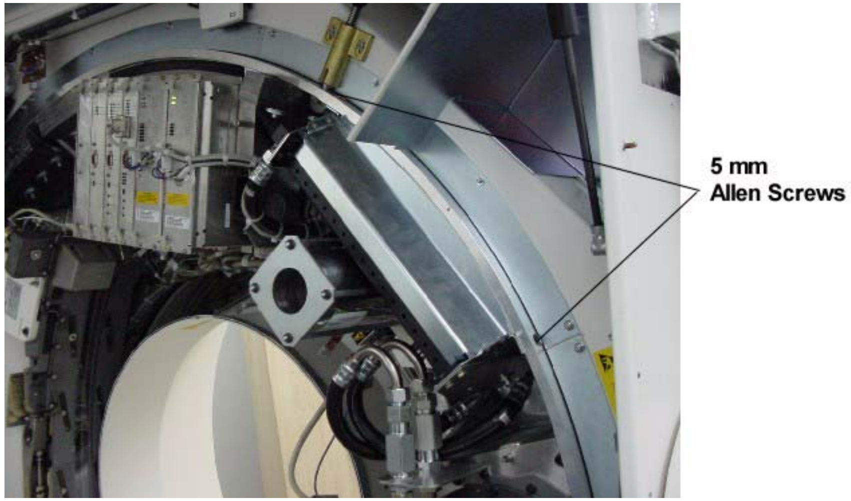


Figure 4-235: Front of Gantry

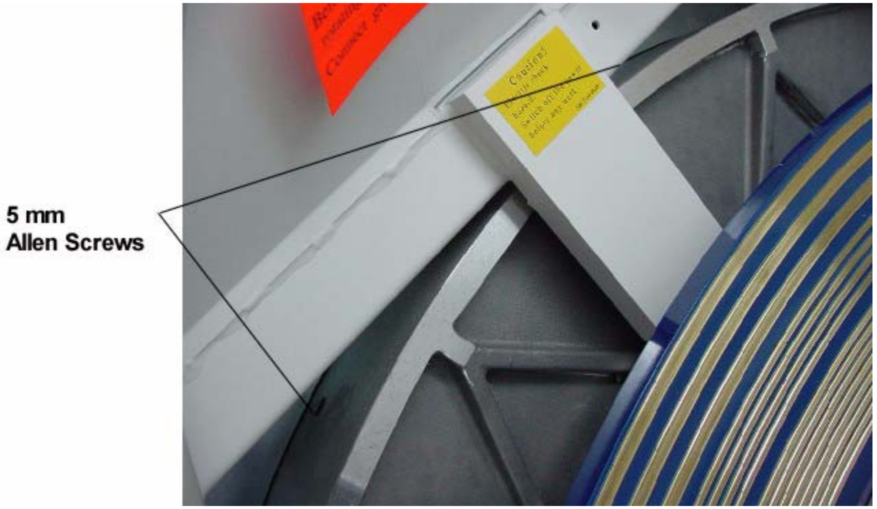


Figure 4-236: Rear of Gantry

9. Use a utility knife to cut the bead of silicone that runs along the edge between the heat exchanger and the rotor (see *Figure 4-237*).
10. There are three 17 mm nuts and washers that secure the pump and bellows. Remove the three nuts and washers with a 17 mm socket wrench and extension. The rubber shock absorbers hold the assembly in place (see *Figure 4-238*).

⚠ CAUTION

BE CAREFUL NOT TO MOVE OR DAMAGE THE LASER LIGHT MARKER WHEN REMOVING THE BELLOWS AND PUMP. IF ONE OF THE LASER LIGHT MARKERS IS MOVED OUT OF ALIGNMENT, SEE THE LASER LIGHT MARKER REPLACEMENT PROCEDURE.

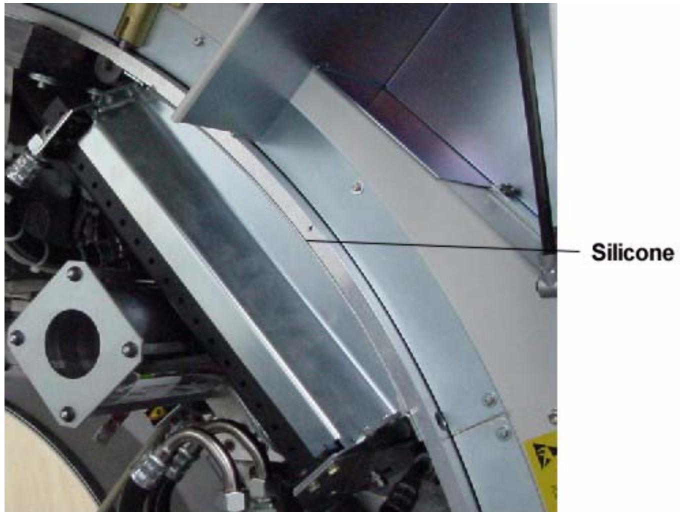


Figure 4-237: Silicone Seal of the Heat Exchanger

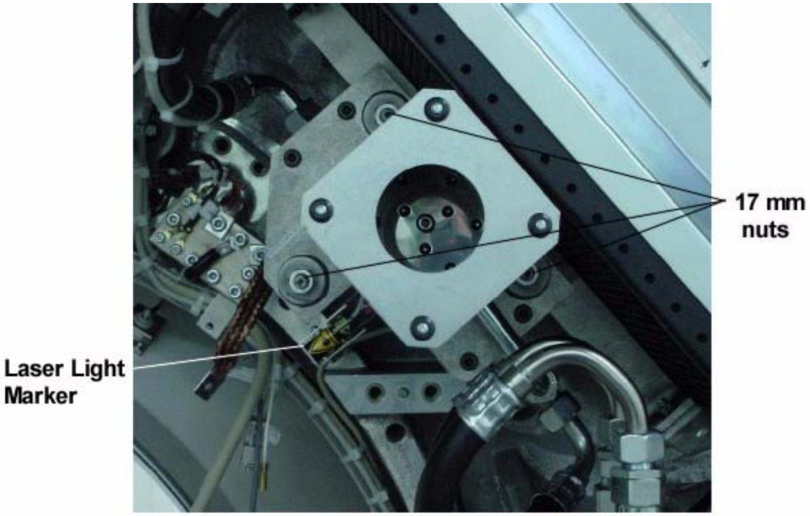


Figure 4-238: Three 17mm Nuts

11. Carefully pull the bellows and pump from the Gantry. Attach this assembly to the x-ray tube with cable ties (see *Figure 4-239*).
12. Remove the three washers behind the bellows.
13. With a 17 mm crescent wrench, remove the two 17 mm nuts and washers that secure the bracket to the rotor (see *Figure 4-240*).
14. Cut the cable ties while holding the pump and bellows. Pull out the heat exchanger with the bellows and pump. Place it on a comfortable work surface.
15. Use a utility knife to remove all of the remaining silicone bead from the rotor. Make sure that stray pieces of old silicone do not fall into the Gantry.

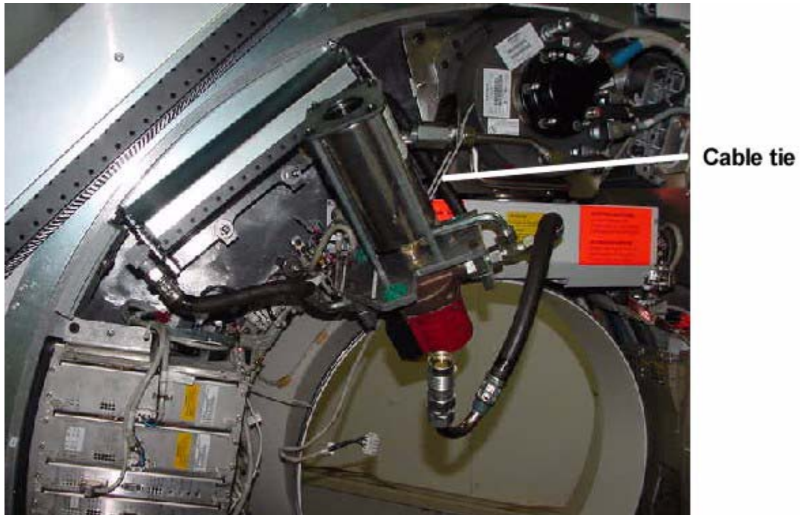


Figure 4-239: Bellows Tied to X-ray Tube

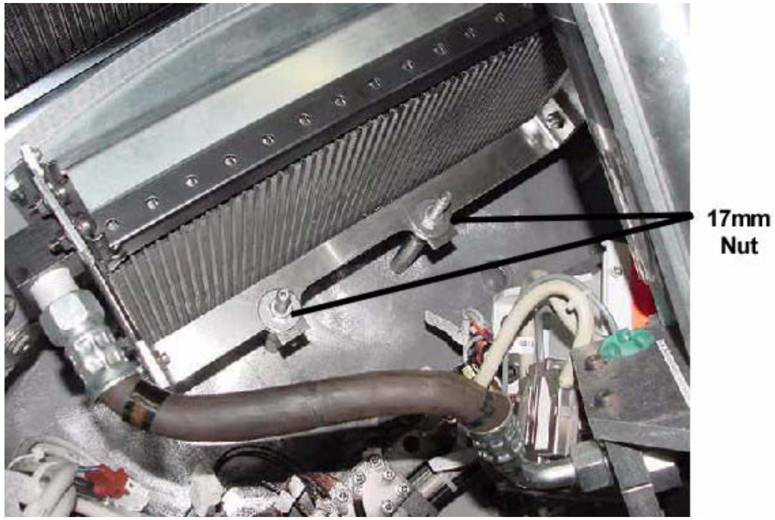


Figure 4-240: 17mm Nuts

Removing the Aluminum Frame

> **NOTE:**
>
> Do not discard the aluminum frame after removing it! Use the aluminum frame with the new heat exchanger.

Separate the heat exchanger from the aluminum frame as follows:

1. Remove the 6 mm Allen screws that hold the bracket under neath the heat exchanger (see *Figure 4-241*). Remove the bracket.

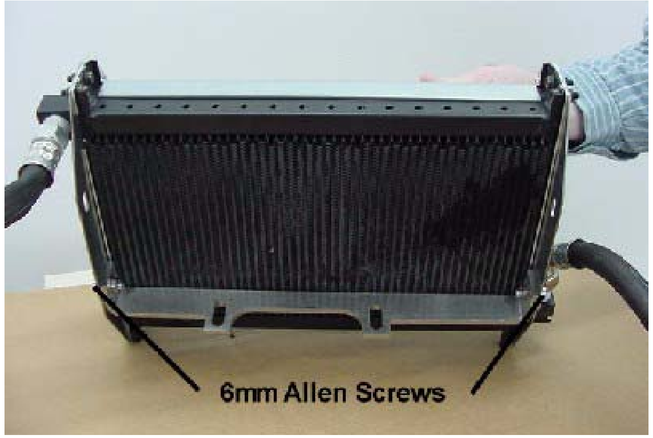


Figure 4-241: Bracket and 6mm Screws

2. Remove the four 5 mm Allen screws (two at the front and two at the rear) from the left side of the heat exchanger (see *Figure 4-242*).

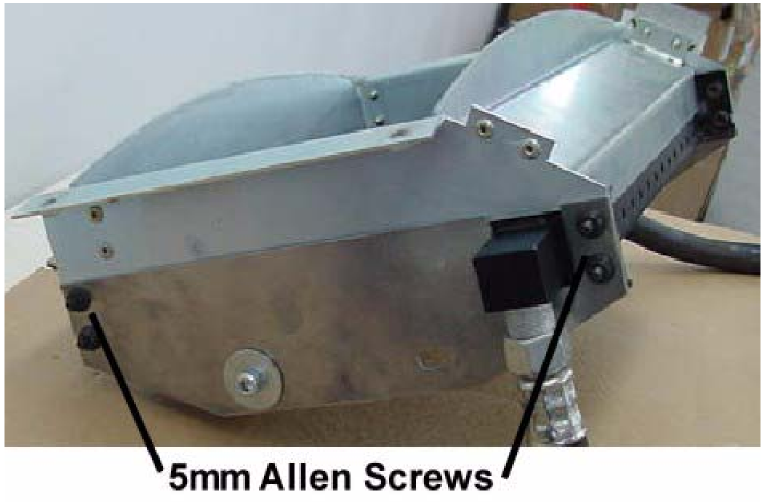


Figure 4-242: Left Side of Heat Exchanger

3. Follow the above procedure for the screws on the right side (see *Figure 4-243*).
4. Remove both side brackets and lift the aluminum frame off the heat exchanger.

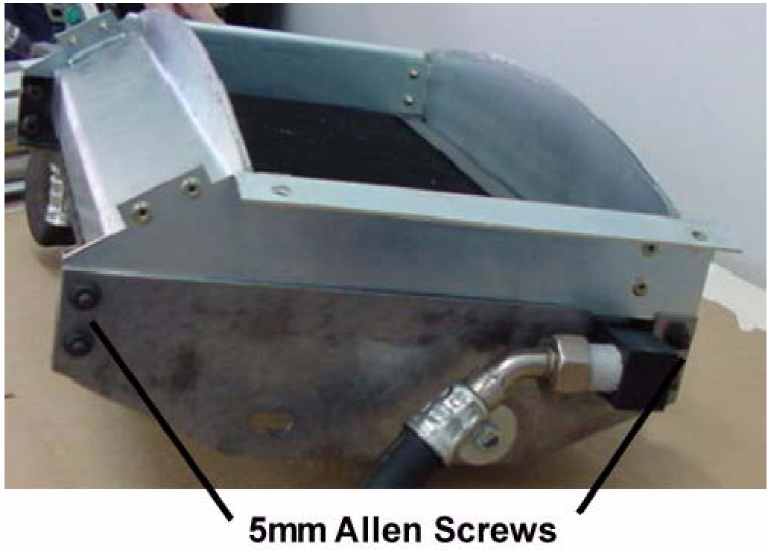


Figure 4-243: Right Side of Heat Exchanger

Installation of the New Assembly

1. Assemble the new heat exchanger to the aluminum frame and the side brackets with the screws removed in *Removing the Aluminum Frame*. Tighten the screws to a torque of 6 Nm.
2. Assemble the bottom bracket removed in *Step 1* of the previous section.
3. Apply silicon on the top edges of the aluminum frame (see *Figure 4-244*).
4. Slide the heat exchanger in position. The bracket underneath the heat exchanger fits on the Gantry bolts.

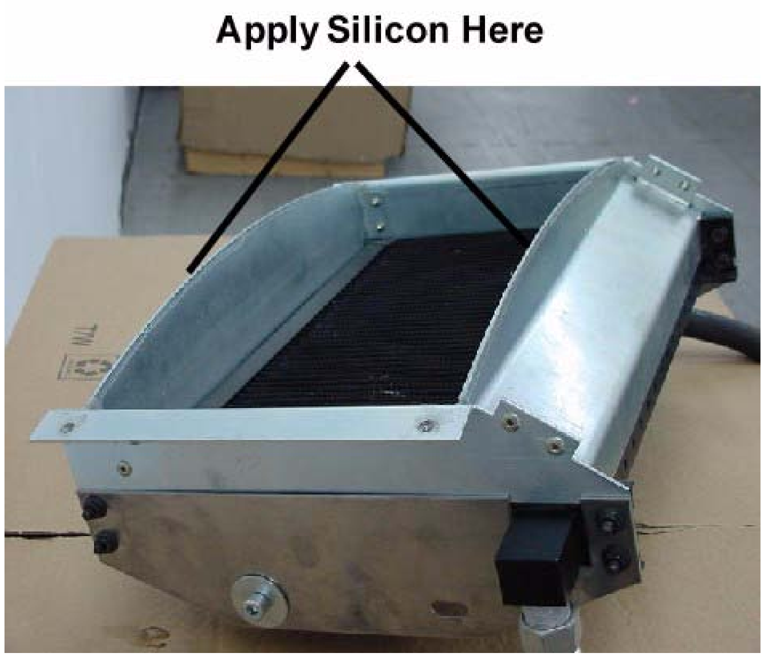


Figure 4-244: Application of Silicon

WARNING

TO ACCESS EACH OF THE TWO 5MM SCREWS FROM THE REAR OF THE GANTRY, IT IS NECESSARY TO UNLOCK AND RE-POSITION THE ROTOR. USE EXTREME CAUTION WHEN DOING SO.

- **MAKE SURE THAT ONE PERSON HOLDS THE ROTOR STATIONARY WHILE REMOVING THE SCREWS.**
- **LOCK THE ROTOR IN THE 3 O’CLOCK POSITION AFTER YOU HAVE REMOVED BOTH SCREWS.**

5. Replace and tighten the four 5mm screws from the outside of the rotor: two from the front of the Gantry and two from the back. Tighten the screws to a torque of 6 Nm.
6. Replace the two washers and tighten the two 14mm nuts that secure the heat exchanger to the bracket on the rotor to a torque of 10 Nm.
7. Assemble the pump and bellows.

NOTE:

Do not use standard torque values for tightening the 17 mm nuts that secure the pump and bellows. Pay special attention to the guidelines in this step for tightening.

8. Tighten the three 17 mm nuts and washers so that the rubber buffers are compressed to a width of 2 mm ±20% (see *Figure 4-245*).
9. Connect the oil lines and cable E535 X2.
10. Release the locking pin.
11. Replace the Gantry covers.

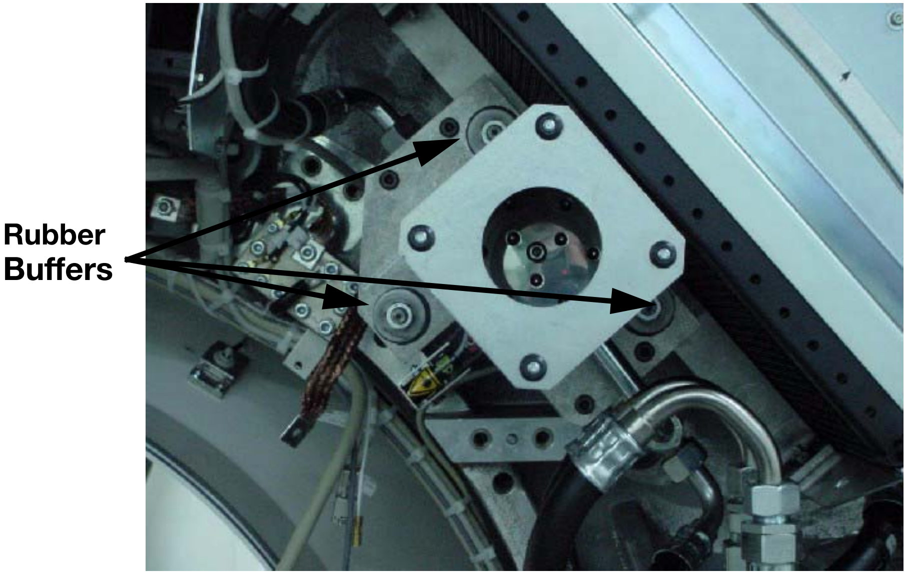


Figure 4-245: Tightening the Rubber Buffers

System Check After Installation

1. Turn the Gantry ON.
2. Bring the system to STBY.
3. Check the oil temperature and the position of the bellows as described in Technical Note CT 2908-028 Tube Cooling Membrane Inspection.
4. Perform a few scans to verify proper functioning.

Replacing the Electronic Box Fan

Read these instructions completely before starting.

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

Tools and Auxiliary Materials Required

No special tools are required for this procedure.

Preparations

Prepare to replace the fan as follows:

1. Move the patient table MAX down and MAX out.
2. Open the front cover of the Gantry and set the S301 switch to the "0" position.
3. Position the electronic box at the 12 o’clock position and close the safety locking pin to prevent Gantry rotation.
4. Switch the Gantry OFF using the Gantry OFF switch on the CT Box.

WARNING

ELECTROCUTION HAZARD. HIGH A/C VOLTAGE IS EXPOSED IN MANY LOCATIONS AND 560 V DC IS PRESENT ON THE ROTOR SLIP RINGS. ALLOW 5 MINUTES FOR POWER TO BLEED OFF THE PDC CAPACITORS BEFORE

WORKING ON THE EQUIPMENT. THE CAPACITOR BANK IS DISCHARGED TO APPROXIMATELY 40 V DC WHEN THE TWO LEDS ON D450 ARE OFF. FAILURE TO COMPLY WILL RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

Removing the Old Fan

Remove the old fan as follows:

1. Disconnect the power cable from the defective fan (see *Figure 4-246*):
    - — Fans M1 and M2 are connected to E603-X1
    - — Fans M3 and M4 are connected to E603-X6
2. Remove the four screws that hold the defective fan.
3. Remove the defective fan.

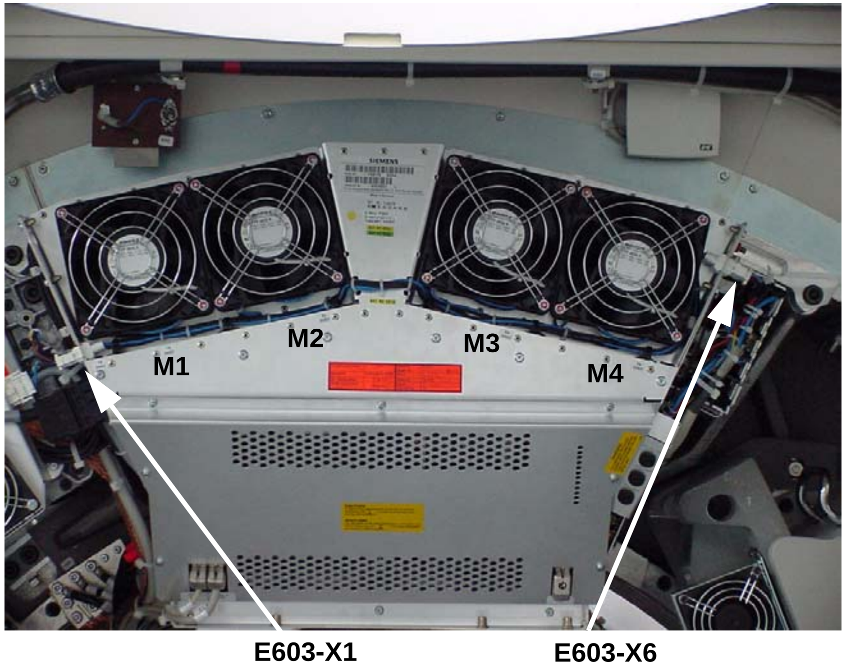


Figure 4-246: Fan Cables

Installing the New Fan

After removing the old fan, install the new one as follows:

1. Put the new fan in position as shown in *Figure 4-246*.
2. Secure the four fan screws and tighten them using a torque of 1.5 Nm.

Final Steps

Complete the replacement of the fan as follows:

1. Connect the power cable that was disconnected when removing the defective fan (see *Figure 4-246*).
2. Secure all cables with cable ties.

Tests and Adjustments

1. Set the S301 switch to the "1" position.
2. Release the safety locking pin.
3. Close the Gantry front cover.
4. Turn ON the system from the CT Box.
5. Perform the Frequency Adaptation procedure (see *“Frequency Adaptation Calibration”*)
6. Perform a scan from the Host and verify the proper functioning of the system.

Replacing Fuses F4 and F5 in the Electronic Box

Read these instructions completely before starting.

Follow all general safety guidelines and radiation protection ordinances (see *“Safety Guidelines”*).

⚠ WARNING ⚠

ELECTRICAL HAZARD! BEFORE BEGINNING WORK ON THE X-RAY SYSTEM, DO THE FOLLOWING:

- **WAIT FOR THE CAPACITOR BANK TO DISCHARGE COMPLETELY. THE CAPACITOR BANK IS COMPLETELY DISCHARGED WHEN THE TWO YELLOW LEDS ON D450 INSIDE THE PDC ARE OFF.**
- **MEASURE THE UDC VOLTAGE ON UDC_pos AND UDC_neg AT THE FOLLOWING POINTS:**
  - IN THE STATIONARY GENERATOR
  - ON THE SLIP RING AT THE BACK OF THE GANTRY
  - ON THE ELECTRONIC BOX OF THE GENERATOR
- **DISCHARGE DISCONNECTED HIGH VOLTAGE CABLES.**

Tools and Auxiliary Materials Required

No special tools are required for this procedure.

Preparations

Prepare to replace fuses as follows:

1. Move the patient table MAX down and MAX out.
2. Open the front cover of the Gantry and set the S301 switch to the "0" position.
3. Position the electronic box at the 3 o’clock position and close the safety locking pin to prevent Gantry rotation.
4. Switch the Gantry OFF using the Gantry OFF switch on the CT Box.

WARNING

ELECTROCUTION HAZARD. HIGH A/C VOLTAGE IS EXPOSED IN MANY LOCATIONS AND 560 V DC IS PRESENT ON THE ROTOR SLIP RINGS. ALLOW 5 MINUTES FOR POWER TO BLEED OFF THE PDC CAPACITORS BEFORE

WORKING ON THE EQUIPMENT. THE CAPACITOR BANK IS DISCHARGED TO APPROXIMATELY 40 V DC WHEN THE TWO LEDS ON D450 ARE OFF. FAILURE TO COMPLY WILL RESULT IN SERIOUS INJURY OR DEATH TO SERVICE PERSONNEL.

Changing the Fuses

The F4 and F5 fuses are behind the electronic box of the generator. Change the fuses as follows:

1. Disconnect the following connectors located on the upper-right side of the funnel:
   - — X312
   - — X325
2. Remove the four nuts securing the funnel.
3. Remove the funnel (see *Figure 4-247*) to access the F4 and F5 fuses.

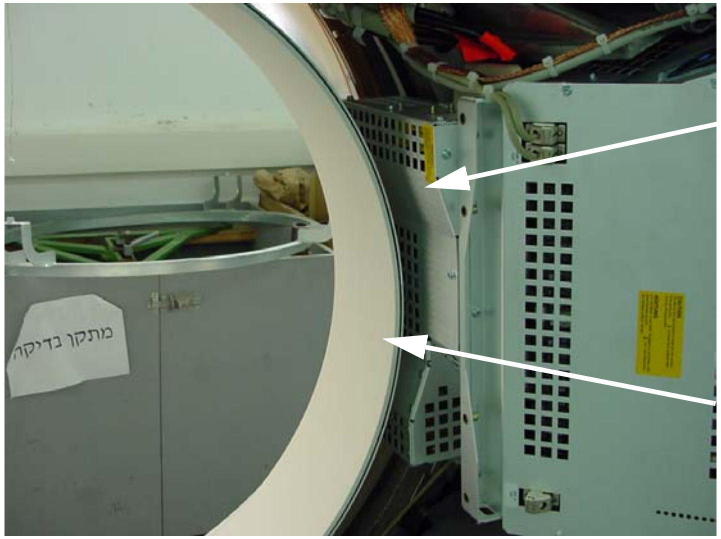


Figure 4-247: Funnel and Fuse Location

4. Remove the 12 screws that hold the metal cover
5. Remove the metal cover (see *Figure 4-248*).
6. Replace the fuses.
7. Replace the metal cover and tighten the 12 screws to a torque of 3 Nm.

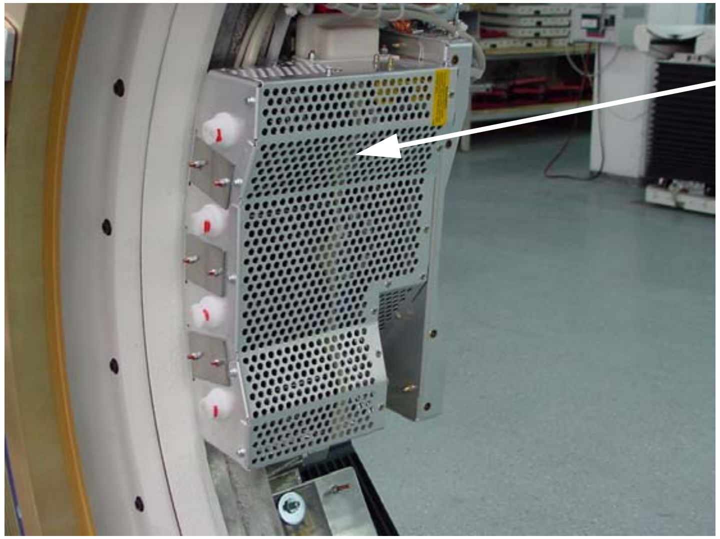


Figure 4-248: F4 and F5 Fuses and Metal Cover

Final Steps

Complete the replacement of the fuses as follows:

1. Replace the funnel.
2. Tighten the four funnel nuts.
3. Connect the cables to the following connectors:
   - X312
   - X325

Tests and Adjustments

1. Set the S301 switch to the "1" position.
2. Release the safety locking pin.
3. Close the Gantry front cover.
4. Turn ON the system from the CT Box.
5. Perform the Frequency Adaptation procedure (see *“Frequency Adaptation Calibration”*)
6. Perform a scan from the Host and verify the proper functioning of the system.

Chapter 5
Patient Table

Functional Description 5-1

The Main Assemblies 5-1
Patient Table Horizontal (PTH) Controller 5-3
Patient Table Vertical (PTV) Controller 5-3
Horizontal Movement 5-3
Tabletop Drive 5-6
Tabletop Drive Signals 5-10
Top Support Drive 5-11
Vertical Movement 5-16
Vertical Movement 1 5-16
Vertical Movement 2 5-22
Vertical Movement Signals 5-24
Power Supply 5-25
Power Supply Signals 5-28

Parts Replacement 5-30

Removing Table Covers 5-30
Procedure 5-31
Bellows/Vertical Electronics (D702) 5-33
Tabletop/Horizontal Electronics (D701) 5-33
Preparation 5-35
Main Procedure 5-36
Installing the Covers 5-39
Table Lift Motor 5-40
Removing the Table Lift Motor 5-42
Installing the Table Lift Motor 5-45
Inverter for the Table Lift Motor 5-48
Removing the Inverter for the Table Lift Motor 5-49
Installing the Inverter for the Table Lift Motor 5-50
Final Steps 5-50
PT Vertical Board 5-51
Removing the PT Vertical Board 5-52
Installing the PT Vertical Board 5-53
Connect Switch S704 5-54
Removing Connect Switch S704 5-55
Installing Connect Switch S704 5-55
Spindle Brake 5-57
Removing the Spindle Brake 5-59
Installing the Spindle Brake 5-59

Vertical Position Potentiometer 5-61
    Installing the Vertical Position Potentiometer 5-63
Horizontal Tabletop Motor 5-64
    Removing the Horizontal Tabletop Motor 5-66
    Installing the Horizontal Tabletop Motor 5-67
Tabletop Encoder 5-68
    Removing the Tabletop Encoder 5-70
    Installing the Tabletop Encoder 5-70
Horizontal Motor for Tabletop Support 5-71
    Removing the Horizontal Motor for the Tabletop Support 5-72
    Installing the Horizontal Motor for the Tabletop Support 5-73
PT Horizontal Board 5-74
    Removing the PT Horizontal Board 5-75
    Installing the PT Horizontal Board 5-76
Tabletop Drive 5-77
    Removing the Tabletop Drive 5-78
    Installing the Tabletop Drive 5-86
Top Support Drive 5-94
    Removing the Top Support Drive 5-95
    Installing the Top Support Drive 5-103
Upper Side Table Covers 5-111
    Removing Upper Side Table Covers 5-112
    Installing 5-117

Adjustment and Calibration **5-120**

Patient Table Horizontal (PTH) Adjustment 5-120
    Introduction 5-120
    Tools Required: 5-120
    System Preparation: 5-122
    Tabletop Adjustment 5-126
    Tabletop Support Adjustment 5-128
    Verifying Couch Accuracy 5-129
Patient Table Vertical (PTV) Adjustment 5-130
    Introduction 5-130
    Required Materials 5-130
    Procedure 5-131

Troubleshooting 5-138

Cleaning of the Couch Vertical Motor Brake 5-138
  Procedure 5-138
  Final Step 5-140

Functional Description

The Main Assemblies

The Patient Handling System (PHS) of the Mx8000 supports spiral and interventional CT options.

The mechanical assembly of the PHS consists of the following:

- Tabletop cradle where the patient is positioned
- Top support which holds the tabletop
- Spindle and scissors to raise and lower the whole Patient Table, i.e., move it vertically

See *Figure 5-1* for a block diagram of the Patient Handling System (PHS).

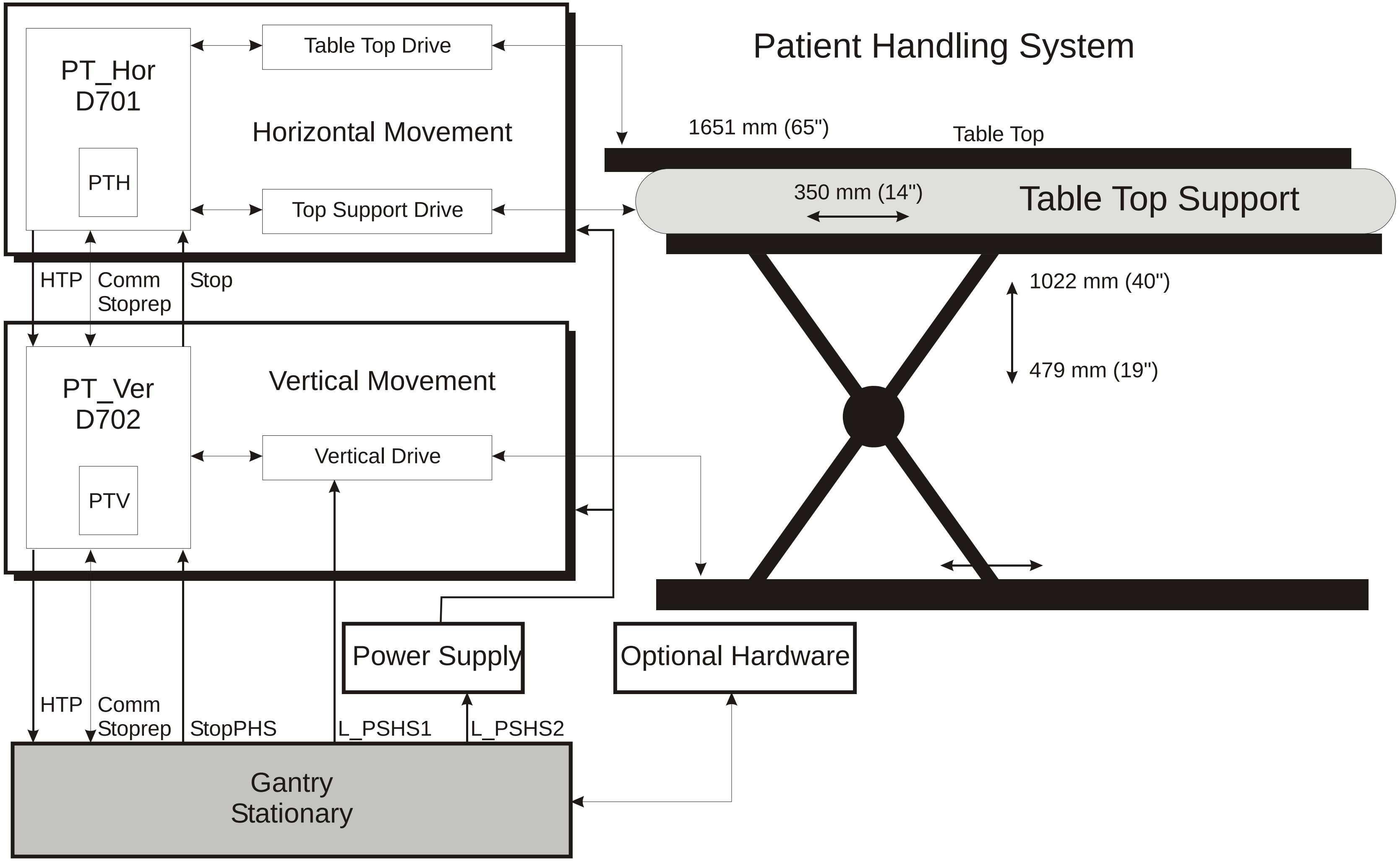

PT_Hor
D701
PTH
Table Top Drive
Horizontal Movement
Top Support Drive
HTP
Comm
Stoprep
Stop
PT_Ver
D702
PTV
Vertical Movement
Vertical Drive
Power Supply
Optional Hardware
HTP
Comm
Stoprep
StopPHS
L_PSHS1
L_PSHS2
Gantry
Stationary
Patient Handling System
1651 mm (65")
Table Top
350 mm (14")
Table Top Support
1022 mm (40")
479 mm (19")

Figure 5-1: Patient Handling System (PHS)

Patient Table Horizontal (PTH) Controller

Both the tabletop cradle and the top support, can be moved independently horizontally. Each has its own motor, driving belt, position sensors and encoders for defining the exact horizontal position of the table.

The Patient Table Horizontal (PTH) controller on the **PT_Hor** D701 board drives both motors.

Patient Table Vertical (PTV) Controller

The Patient Table is moved vertically by rotating a spindle to open or close the scissors, thereby, raising or lowering the table.

The Patient Table Vertical (PTV) controller on the **PT_Ver** D702 board controls vertical movement. A tow rope potentiometer with a signal conditioner records the absolute table height and generates a current of 4-20 mA for 0-100% distance. The motor is driven by the vertical frequency converter.

All connections to the Patient Handling System (PHS) come from the Gantry Stationary. They include the following:

- CAN bus - for communication
- Horizontal table pulses for surview and spiral measurement. When the tabletop travels horizontally, these pulses are generated and transmitted to the DMS through the Gantry Stationary and the slip rings.
- AC voltage supply for the following Patient Handling System units:
  - DC power supply
  - Vertical Frequency converter

Horizontal Movement

The Patient Table Horizontal (**PT_Hor** D701) board, with its on-board MCB D2 controller, controls horizontal movement of the Patient Table. For communication, safety and control purposes, the board is linked to the Patient Table Vertical (**PT_Ver** D702) board, and (from there) to the rest of the unit (see *Figure 5-2*).

The following two drive systems implement horizontal movement:

- **The Tabletop Drive** moves the table top (with the patient) horizontally, in and out of the Gantry funnel.

  A 24 VDC motor that is connected by a clutch to a toothed belt, moves the tabletop. Two brakes hold the tabletop in position.

  A potentiometer records the absolute position. A high precision increment encoder issues count pulses according to the relative movement. A proximity reference switch defines the reference position for adjustment of the tabletop.

- **The Top Support Drive** moves the top support (together with the tabletop) horizontally to ICT, or normal position.

  A 24 VDC motor that drives a toothed belt moves the top support, and a brake holds it in position.

  A potentiometer records the absolute position and an increment encoder issues count pulses according to the relative movement. A proximity reference switch defines the reference position for adjustment of the top support. The rear safety switches inform the **PT_Hor** D701 board when an obstacle at the rear inhibits further movement.

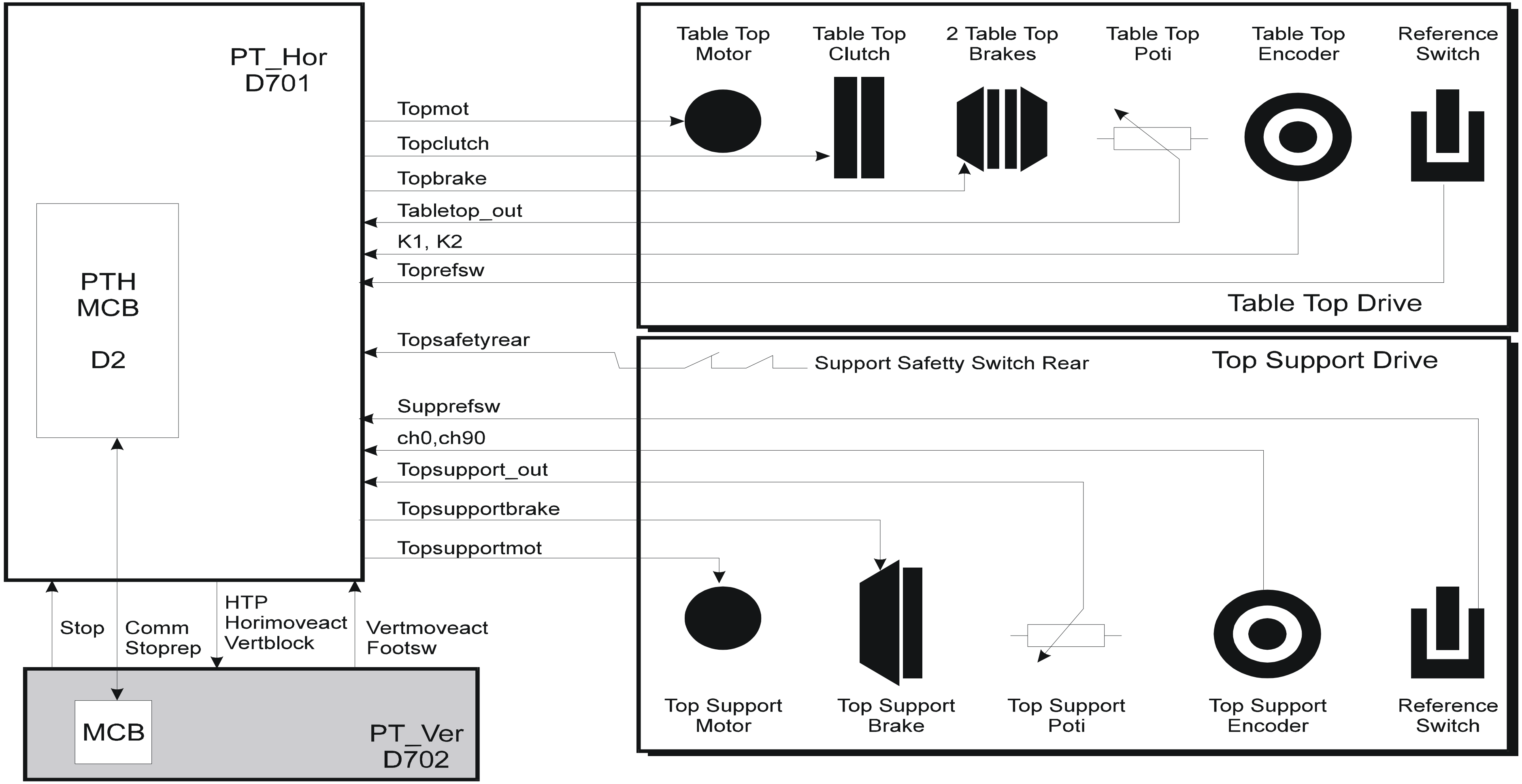

PT_Hor
D701
PTH
MCB
D2
Topmot
Topclutch
Topbrake
Tabletop_out
K1, K2
Toprefsw
Topsafetyrear
Suppref sw
ch0,ch90
Topsupport_out
Topsupportbrake
Topsupportmot
Table Top Motor
Table Top Clutch
2 Table Top Brakes
Table Top Poti
Table Top Encoder
Reference Switch
Table Top Drive
Support Safetty Switch Rear
Top Support Drive
Top Support Motor
Top Support Brake
Top Support Poti
Top Support Encoder
Reference Switch
Stop
Comm
Stoprep
HTP
Horimoveact
Vertblock
Vertmoveact
Footsw
MCB
PT_Ver
D702

Figure 5-2: Patient Handling System (PHS), Horizontal Movement

Tabletop Drive

The tabletop drive of the PHS moves the patient in and out of the Gantry funnel for positioning at a distance of 1651 mm (65 in.). This section describes its modules and functionality (see also *Figure 5-2* and *Figure 5-3*).

The Patient Table Horizontal (PTH) MCB D2 Module

The PTH MCB D2 (**PT_Hor** D701) board contains the on-board PTH MCB D2 module, with the PTH firmware acting as function controller. This module controls horizontal movement of the tabletop and the top support. It also stops the Patient Table Vertical (**PT_Ver** D702) controller from performing invalid vertical movements.

The PTH MCB D2 module is connected to the CAN bus for communication, and is linked into the stop report loop for safety supervision.

The M711 Tabletop Motor

The M711 tabletop motor moves the tabletop with the help of a toothed belt and wheels. This 24 VDC motor has a built-in gear of 1:36 and is supplied with pulse width modulation voltage regulated by a motor controller.

The Tabletop Motor Controller

The tabletop motor controller is programmed by the PTH function controller to include acceleration, speed and the desired table position. From these parameters, the motor controller calculates a trapezoid speed profile for movement regulation.

The PWM and Sign Signals

The PWM and Sign signals are fed into the tabletop driver for power amplification. As a prerequisite, the stop circuit (**Stoppos** and **Stopneg**) must be closed to supply **Table_24V** to the driver.

A B711 Increment Encoder

The B711 increment encoder that is connected with another toothed belt to the tabletop motor axis registers tabletop movement. The B711 is a high precision module that generates 10,000 pulses per revolution, which correspond to 500 pulses per 1 mm (0.039 in.) of tabletop movement.

A PLD Logic Module

PLD logic module on the PTH MCB D701 board processes and evaluates the K1 and K2 signals. It then feeds high precision incremental pulses back into the tabletop motor controller for exact position regulation and uses a divider to generate Horizontal Table Pulses (HTP) from the incremental pulses. The HTPs are transmitted to the PTH function controller, which sends them as differential HTP Pos and Neg signals via the **PT_Ver** D702 board and the Gantry, to the DMS.

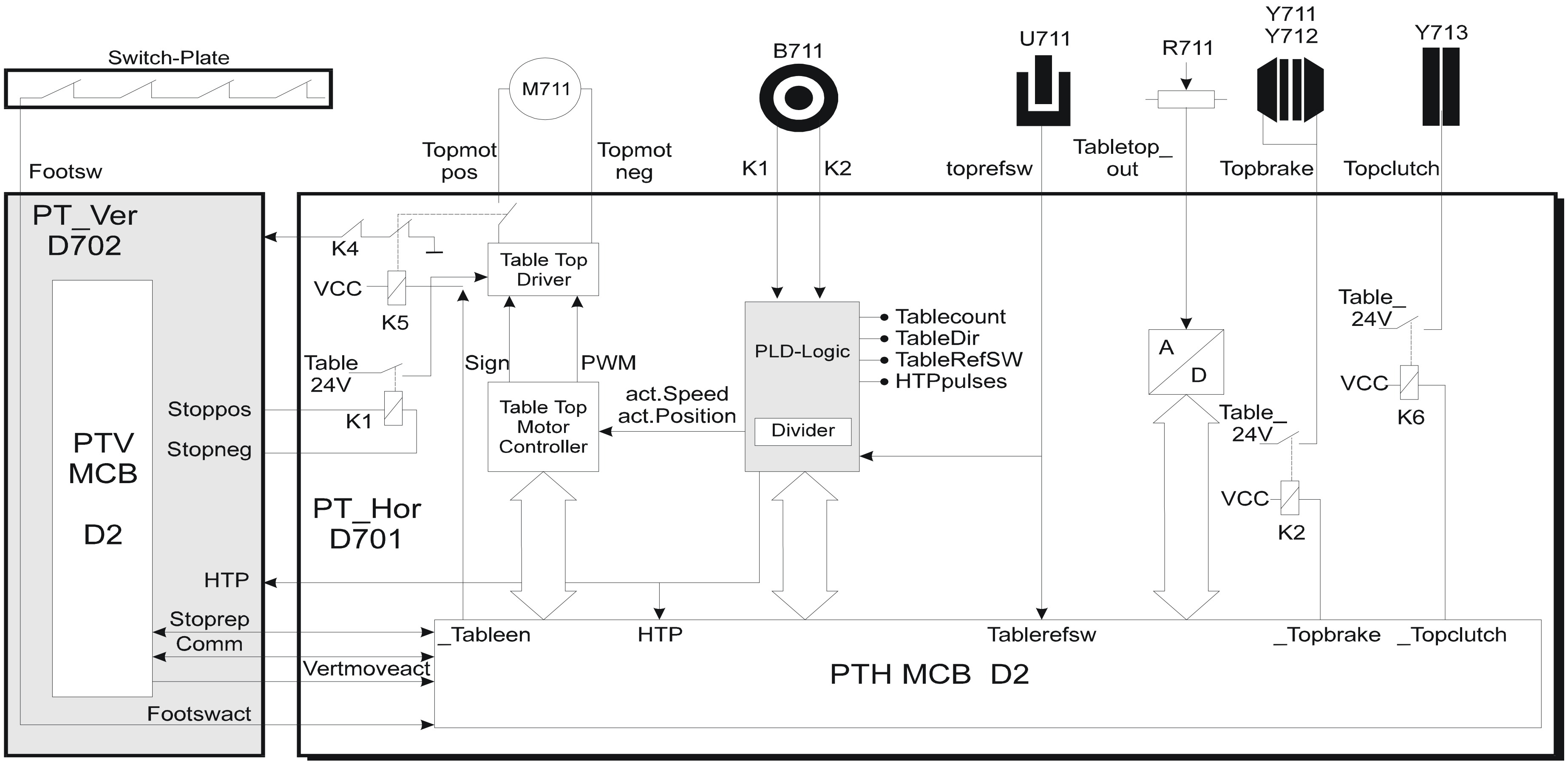

Switch-Plate
M711
B711
U711
R711
Y711
Y712
Y713
Footsw
Topmot pos
Topmot neg
K1
K2
toprefsw
Tabletop_ out
Topbrake
Topclutch
PT_Ver D702
K4
VCC
K5
Table Top Driver
Table 24V
K1
Sign
PWM
Table Top Motor Controller
act.Speed
act.Position
PLD-Logic
Divider
Tablecount
TableDir
TableRefSW
HTPpulses
A
D
Table_ 24V
VCC
K6
Table_ 24V
VCC
K2
PTV MCB
D2
Stoppos
Stopneg
HTP
Stopprep
Comm
Vertmoveact
Footswact
PT_Hor D701
_Tableen
HTP
Tablerefsw
_Topbrake
_Topclutch
PTH MCB D2

Figure 5-3: Patient Handling System, Horizontal Movement, Tabletop Drive

The U711 Proximity Switch

The U711 proximity switch becomes active when the tabletop approaches the end of its range at the back. The U711 switch signal marks the reference tabletop position and is evaluated by the PLD logic and the function controller. U711 is used during adjustment and to set the zero position of the table.

The Tabletop Pita R711 Potentiometer

The tabletop Pita Potentiometer roughly determines the position of the tabletop after startup. The analog signal is converted to digital as channel 1 of the D701 on-board A/D-converter. The digital value is then reported to the function controller.

The tabletop positions and their corresponding potentiometer values are recorded during table adjustment.

The Y713 Clutch

The Y713 clutch separates the tabletop motor from the mechanical motor drive assembly. The function controller applies the clutch with relay K6 and a 24 VDC supply.

The E703 Foot Switch Pedal

The E703 foot switch pedal on the cable duct between the Gantry and the PHS, allows faster patient positioning. This tabletop release is only enabled when the top support is in the inner (not ICT) or outer (ICT) position.

The Foot Switch is not a safety feature. If it is pressed, the function controller interrupts horizontal table movement, and releases the tabletop, brakes and clutch. In addition, the CAN bus stops Gantry tilt movement. However, the brake for the top support stays engaged.

The Mechanical Tabletop Brakes (Y711 and Y712)

The mechanical tabletop brakes (Y711 and Y712) stop tabletop movement and hold the tabletop in position. One brake is on the motor side of the tabletop and the other is on the opposite side, at the Gantry end of the toothed belt drive.

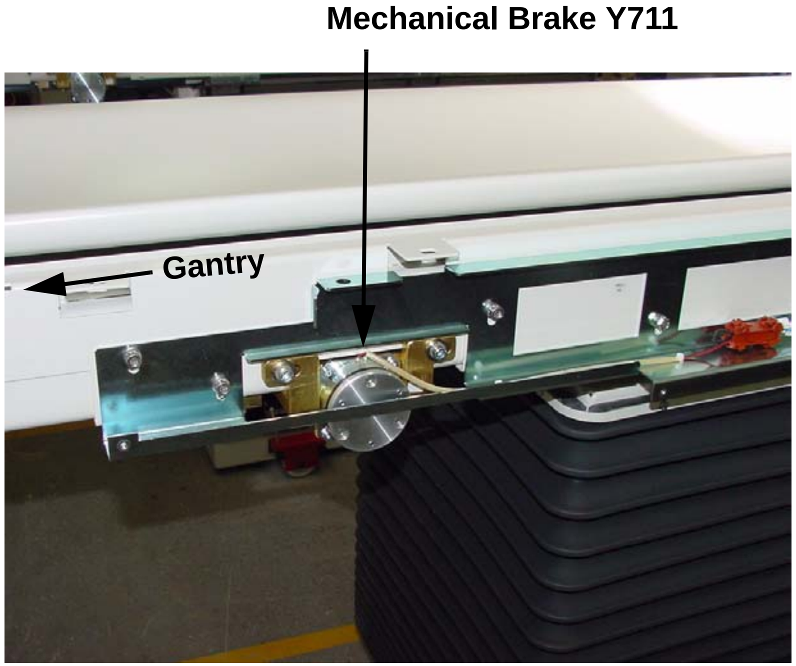


Figure 5-4: Mechanical Tabletop Brake Y711
(Viewed with Left Side Cover Removed)

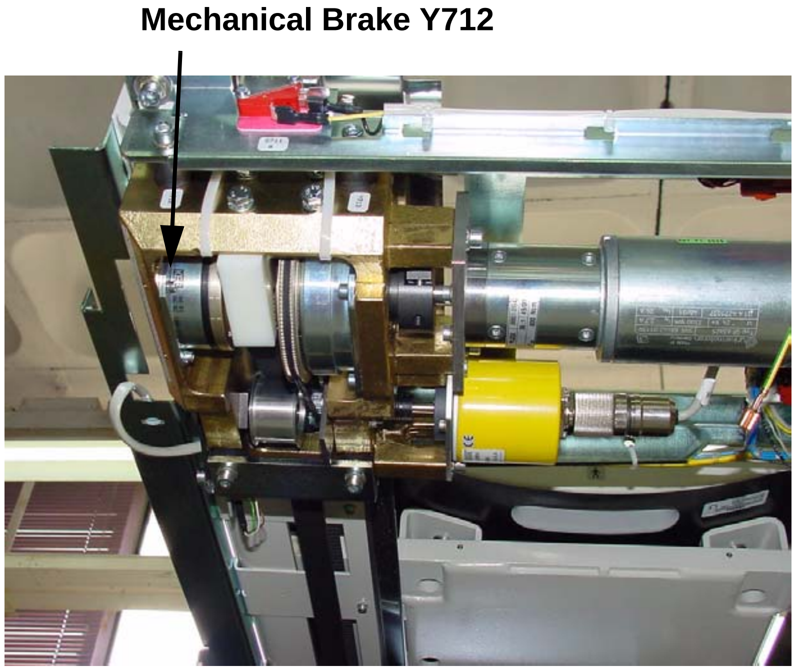


Figure 5-5: Mechanical Tabletop Brake Y712
(Viewed with Bottom Cover Removed)

The brakes are activated by the function controller with K2 relay and a 24 VDC supply.

Free Manual Horizontal Movement

In the following cases, the tabletop is released for free manual movement and the tabletop clutch and both tabletop brakes are inactive:

- In the STOP state
- When the power is OFF
- If the foot switch is activated

Tabletop Drive Signals

TableCount	Encoder pulses.
TableDir	Direction movement from K1 and K2 of the encoder.
Table_RefSw	Table zero position (tabletop is close to the end of its range at the back).
HTPpulses	HTP (Horizontal Table Pulses) generated from increment pulses
PWM, Sign	Controller output signals. **PWM** is a pulse width modulated (PWM) signal to control the speed, and Sign indicates the direction.
K1, K2	The tabletop encoder generates these two signals, where K1 is direct and K2 is a 90 degrees phase-shifted signal that is used later for direction detection. Both signals are transmitted to the **PT_Hor** D701 board as differential signals.
_Tableen	To enable table movement, the function controller issues this signal. Then, relay K5 applies the supply voltage to the motor and informs the Patient Table Vertical (**PT_Ver** D702) board, that horizontal table movement is active.
HoriMoveAct	To enable table movement, the function controller issues this signal. Then, relay K5 applies the supply voltage to the motor and informs the Patient Table Vertical (**PT_Ver** D702) board, that horizontal table movement is active by issuing the **Horimoveact** signal.
VertMoveAct	**PT_Ver** D702 also notifies the Patient Table Horizontal (**PT_Hor** D701) board when vertical movement is active.

Top Support Drive

The Top Support Drive of the Patient Handling System (PHS) moves the top support together with the tabletop as follows:

- Towards the Gantry for scanning in regular (not ICT) mode
- Away from the Gantry for scanning in ICT mode

When the top support is extended to its inward limit, it is still 350 mm (13.779 in.) from the Gantry. This leaves room for interventional CT equipment between the PHS and the Gantry.

Do not try to position the table top for TOPO, SEQUENCE or SPIRAL mode when the top support is in an intermediate position. If the top support is in an intermediate position, the system prompts the operator to re-position the patient support.

The following sections describe its functionality (see also *Figure 5-6*).

Function Controller

The PTH function controller on the **PT_Hor** D701 board also controls the movement of the top support with regard to any vertical and tilt activity to avoid collision between the Patient Table and the Gantry.

Support Motor

The M710 top support motor moves the top support with a toothed belt and wheels. The motor is a 24 VDC motor with a built-in gear of 1:36. It is supplied with pulse width modulation voltage that is regulated by a motor controller.

Motor Controller

The patient table horizontal function controller sets the acceleration, speed and table position for the top support motor controller. The motor controller uses these parameters to calculate a trapezoid speed profile for movement regulation.

Power Driver

The **PWM** and **Sign** signals are fed into the top support driver for power amplification. As a prerequisite, the stop circuit **Stoppos** and **Stopneg** must be closed to supply **24V_supp** to the driver.

Enabling Top Support Movement

The function controller enables top support movement with the Support Enable (**_Suppen**) signal. Then relay **K4** applies the supply voltage to the motor and informs the Patient Table Vertical (**PT_Ver** D702) board, that horizontal table movement is active.

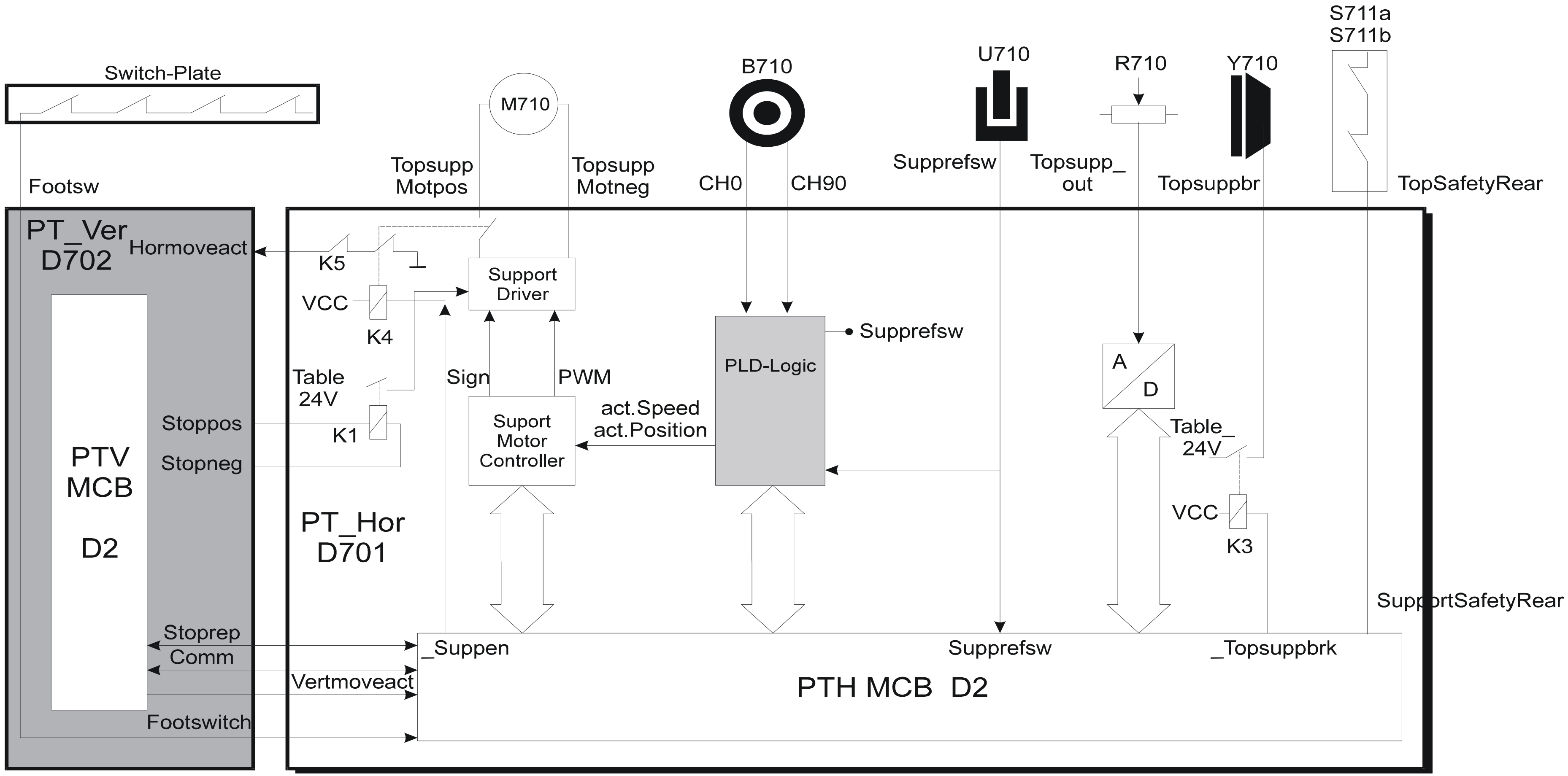

S711a
S711b
U710
R710
Y710
B710
Switch-Plate
M710
Topsupp
Motpos
Topsupp
Motneg
CH0
CH90
Supprefsw
Topsupp_
out
Topsuppbr
TopSafetyRear
Footsw
PT_Ver
D702
Hormoveact
K5
Support
Driver
VCC
K4
Supprefsw
PLD-Logic
A
D
Table
24V
Sign
PWM
act.Speed
act.Position
Suport
Motor
Controller
Table_
24V
Stoppos
K1
Stopneg
PTV
MCB
D2
PT_Hor
D701
VCC
K3
SupportSafetyRear
Stoprep
Comm
Vertmoveact
Footswitch
_Suppen
Supprefsw
_Topsuppbrk
PTH MCB D2

Figure 5-6: Patient Handling System (PHS), Horizontal Movement, Top Support Drive

HoriMoveAct

Horizontal top support movement is enabled by the function controller by using relay **K4** to apply the supply voltage to the motor. Then it issues the Horizontal Move Active (**Horimoveact**) signal to inform the Patient Table Vertical (**PT_Ver** D702) board that horizontal table movement is active.

Encoder

Top support movement is registered by a **B710** increment encoder on the motor axis of the top supports. **B710** generates 2500 pulses per revolution, which corresponds to 60 pulses in 1 mm (0.039 in.) of top support movement.

Ch0, Ch90

The top support encoder generates **Ch0** as a direct signal and **Ch90** as a 90 degrees phase-shifted signal that is used later for direction detection. Both signals are transmitted to the **PT_Hor** D701 board as differential signals.

PLD Logic

On the D701 board, the **Ch0** and **Ch90** signals are processed and evaluated in the PLD logic module. From there, the high precision incremental pulses are fed back into the top support motor controller for exact position regulation.

Support Reference Switch

The **U710** proximity switch is activated when the top support approaches the end of its range at the rear. This switch signal marks the reference top support position and is evaluated by the PLD logic and by the function controller. **U710** is used during adjustment and to set the zero table position.

Top Support Potentiometer

Potentiometer **R710** roughly determines the position of the top support after startup. The analog signal is converted to a digital signal as channel 0 of the A/D-converter, and the digital value is read to the function controller. The top support position and potentiometer values are cross-referenced. They are recorded during table adjustment.

Top Support Brake

The **Y710** brake stops the top support motor drive and holds it in position. The brake is activated by the function controller with relay **K3** and a 24 VDC supply.

Support Safety Switches Rear

A safety switch plate, with **S711a** and **S711b** at the rear of the top support, stops horizontal movement whenever the top support encounters an obstacle when moving outwards.

VertMoveAct

Indicates to the PTH that vertical movement is active.

Vertical Movement

Vertical movement is described in two sections: *"Vertical Movement 1"* and *“Vertical Movement 2” on page 5-22*.

Vertical Movement 1

The Patient Table Vertical (**PT_Ver**) D702 board, with its on-board MCB D2 function controller, controls vertical movement of the Patient Table. The board connects the PHS to the Gantry Stationary for communication, safety and control purposes. It also passes these signals to the Patient Table Horizontal (**PT_Hor** D701) board (see *Figure 5-7* for a block diagram).

Vertical Drive

The vertical drive lowers and raises the top support and the table top through a spindle and scissors arrangement.

Spindle Motor

The spindle is driven by a three phase AC motor. The supply of the AC motor is generated by a frequency converter. A motor brake and a thermal switch inside the motor housing prevent overheating of the motor.

Spindle Brake

The ball screw spindle is not self-locking. It is held in position by a solenoid spindle brake.

Potentiometer

A tow rope potentiometer with a signal conditioner records the absolute table height and generates a current of 4-20 mA for 0-100% distance.

Release Switch

The proximity release switch defines the reference position for adjustment. Proximity switch **U702** is activated when the table position is higher than 155 mm (6.102 in.), on the display. Activating **U702** allows horizontal movement with a tilted Gantry.

Connect Switch

The connect switch reports if the spindle nut and the scissors no longer have contact and disables downward couch movement. This condition indicates that the spindle is rotating, but an obstacle under the table is preventing the scissors from lowering the table.

Stop Relay

The **D703** stop relay disconnects the frequency converter from the power when a stop condition occurs.

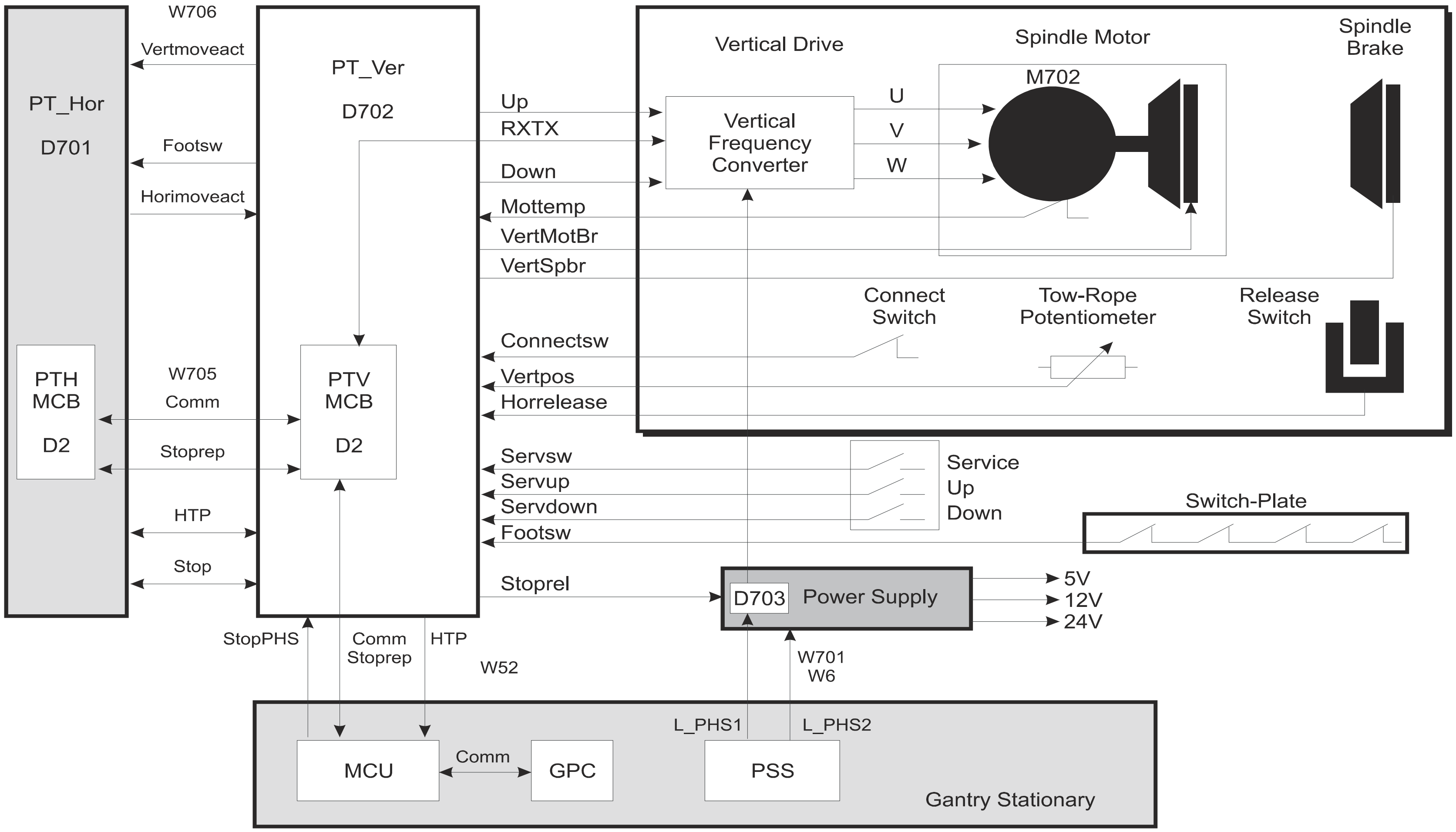

W706
Vertmoveact
PT_Hor
D701
Footsw
Horimoveact
PT_Ver
D702
Up
RXTX
Down
Mottemp
VertMotBr
VertSpbr
Connectsw
Vertpos
Horrelease
Servsw
Servup
Servdown
Footsw
Stoprel
Vertical Drive
Vertical Frequency Converter
U
V
W
Spindle Motor
M702
Spindle Brake
Connect Switch
Tow-Rope Potentiometer
Release Switch
Service
Up
Down
Switch-Plate
D703
Power Supply
5V
12V
24V
PTH MCB D2
W705
Comm
Stoprep
PTV MCB D2
HTP
Stop
StopPHS
Comm Stoprep
HTP
W52
W701
W6
L_PHS1
L_PHS2
MCU
Comm
GPC
PSS
Gantry Stationary

Figure 5-7: Patient Handling System (PHS), Vertical Movement 1

Switch Plate

The plate between Gantry and the PHS serves as a foot switch to immediately stop PHS movement and Gantry tilt, and to mechanically release the tabletop for free manual movement.

Range of Movement

Table movement is restricted by the mechanical limits of the PHS and by the collision check profile. This profile describes the allowed range of movement as a function of the Gantry tilt angle, the table height and horizontal position.

Vertical Position

A tow rope potentiometer with signal conditioner **B702** determines the table height. The analog output is amplified on the **PT_Ver** board and passed to an analog/digital (A/D) converter. The digital height value can be polled by the PTV function controller via the A/D processor bus.

Foot Switch

The electrical connection of the **E703** foot switch plate, with its four switching elements to release the tabletop, runs through the Patient Table Vertical (**PT_Ver**) board. However, the signal is evaluated only on the Patient Table Horizontal (**PT_Hor**) board.

Service Operation

The following three service buttons on the right underside of the table activate Service mode, allow manual operation of the PHS, even without the rest of the system running:

⚠ WARNING

PINCH HAZARD!

THE COLLISION CONTROL BETWEEN THE PATIENT TABLE AND THE GANTRY PROVIDED BY THE SOFTWARE IS DISABLED. THEREFORE, THERE IS A DANGER TO A PATIENT OR DAMAGE TO THE GANTRY OR PATIENT TABLE.

MECHANICAL HAZARD!

WITH SERVICE SWITCH S703 SET TO THE SERVICE POSITION, THERE IS NO UPPER AND LOWER HEIGHT LIMIT. THE SCISSORS CARRIAGE CAN BE DRIVEN INTO THE SUB-FRAME.

EXERCISE EXTREME CAUTION WHEN RAISING OR LOWERING THE PATIENT TABLE WITH SERVICE SWITCH S703 IN THE SERVICE POSITION. FAILURE TO COMPLY CAN RESULT IN *SERIOUS INJURY OR DEATH* TO SERVICE PERSONNEL OR SERIOUS DAMAGE TO THE EQUIPMENT!!!

- Switch **S703** changes to service mode for button operation, ignoring the stop circuit.
- Push button **S702** lowers the Patient Table.
- Push button **S701** raises the Patient Table.

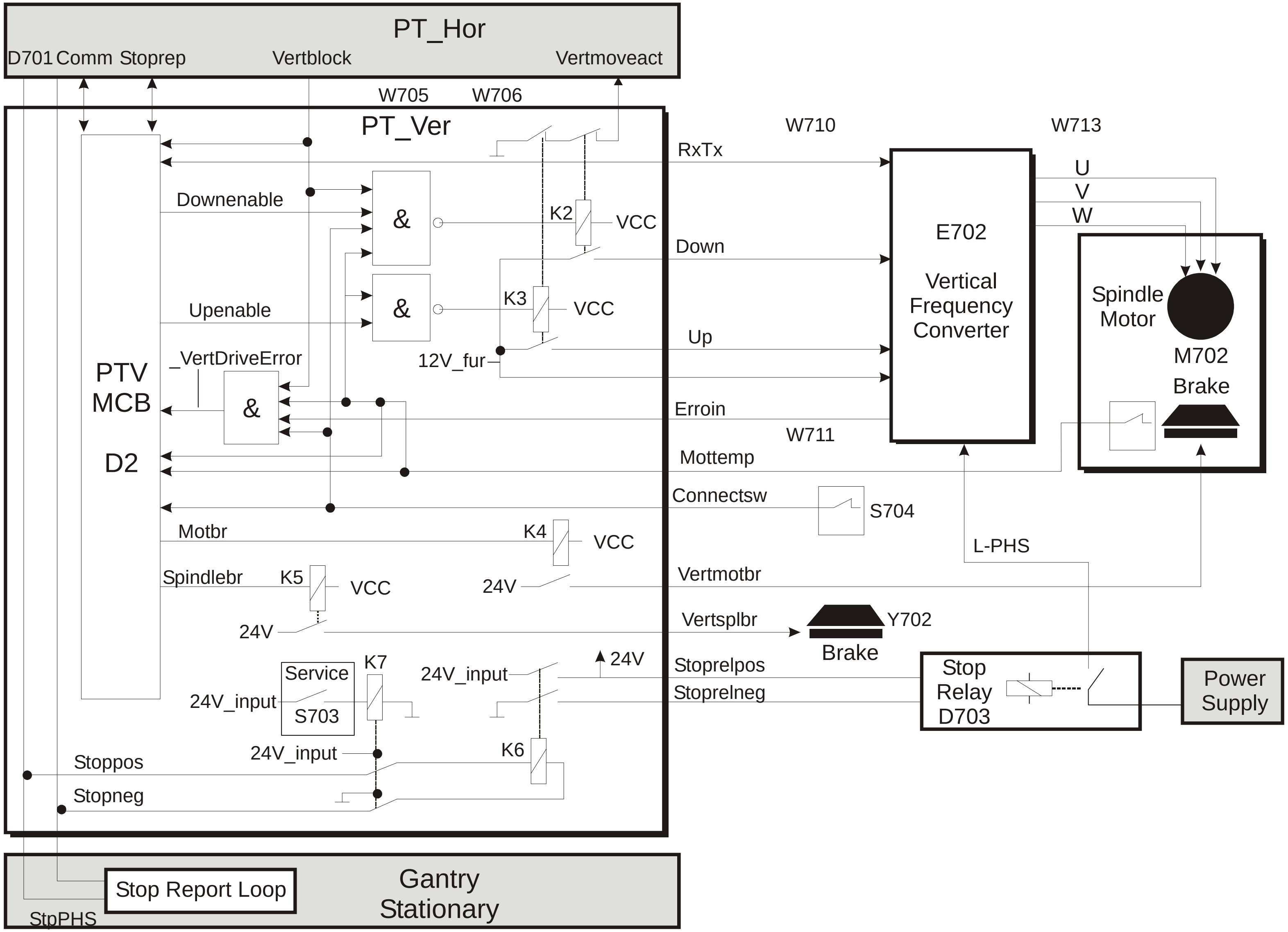

PT_Hor
D701
Comm
Stoprep
Vertblock
Vertmoveact
W705
W706
PT_Ver
PTV
MCB
D2
Downenable
Upenable
_VertDriveError
&
K2
VCC
K3
12V_fur
K4
K5
K6
K7
24V
24V_input
Service
S703
Motbr
Spindlebr
Stoppos
Stopneg
RxTx
Down
Up
Erroin
Mottemp
Connectsw
Vertmotbr
Vertsplbr
Stoprelpos
Stoprelneg
W710
W711
W713
E702
Vertical
Frequency
Converter
U
V
W
Spindle
Motor
M702
Brake
S704
L-PHS
Y702
Brake
Stop
Relay
D703
Power
Supply
Stop Report Loop
Gantry
Stationary
StpPHS

Figure 5-8: Patient Handling System (PHS), Vertical Movement 1 Details

Vertical Movement 2

Vertical 2 movement of the Patient Handling System (PHS) is controlled by Patient Table Vertical (PTV) **PT_Ver** board D702. Its D2 on-board function controller, with the PTV firmware, controls and monitors the table height and checks horizontal movement for any unallowed position.

Communication with the Patient Table Horizontal (PTH) **PT_Hor** board and the rest of the system is via the CAN bus. The PTV firmware is also part of the Stop report loop for safety.

Vertical Drive

The vertical drive lowers and raises the top support and the table, with a spindle and scissors mechanism.

Frequency Converter

The **E702** frequency converter (Lust) controls rotation of the motor. It generates three AC phases, with variable frequency for the spindle motor, from one single AC supply phase. The internal microprocessor sets up and checks the output.

The function controller transmits the required parameters to the converter via MUX serial communications lines and enables the correct direction.

Motor Brake

The motor brake prevents movement of the motor. It is applied with a 24 V line, and switched by the function controller with relay **K4**.

Stop Relay

In normal operation mode, the General System Stop Circuit operates the **D703** solid state stop relay with relay **K6** and either enables power to be supplied to the converter, or cuts it off in a STOP state.

In service mode, the stop relay is always enabled by **K7** and **K6** for converter power supply. In this mode, you can move the PHS vertically for service, even if the whole system is stopped for safety.

Error Signals

Vertical movement is only possible, if no error signal is active. The four error inputs listed below are current loops. On the PT_Ver board, they enter the PTV as opto-isolated active low signals.

The error signal are (see details in Section *"Vertical Movement Signals"*):

- Vertblock
- Mottemp
- ConnectSW
- Erroin

Down Movement

Downward movement is enabled by **K2**, when the following four conditions are met:

- Down_Enable is set by the function controller.
- No vertical block is detected.
- Motor temperature is OK.
- Connection exists between nut and scissors.

Upward movement is enabled by **K3**, when the following two conditions are met:

- Up_Enable is set by the function controller.
- Motor temperature is OK.

Vertical Movement Signals

Vertblock	The Vertblock signal is not used anymore. It is set by jumpers at D701 to be always active.
MotTemp	If the temperature switch of the vertical drive motor opens, this signal indicates motor overheating.
Erroin	This signal indicates an internal error of the frequency converter. It is passed to the PTV MCB as **Error Freq**.
Mottemp	If the temperature switch of the vertical drive motor opens, this signal warns against motor overheating.
RxTx	The function controller transmits the required parameters to the converter via the multiplexed serial communication lines, **RxTx**.
ConnectSW	The **S704** connect switch monitors the mechanical contact of the spindle nut and scissors assembly. The switch opens and disables downward movement, if the spindle is turning and the table does not lower, i.e., when something is blocking vertical movement.
Error	All error signals are applied to a four-way AND-gate, which issues an error interrupt to the PTV with **_VertDriveError**, as soon as one signal becomes active low.
VertMoveAct	**K2** and **K3** also inform the Patient Table Horizontal (**PT_Hor**) board if vertical movement is active.

Power Supply

(see *Figure 6-2* for additional information)

During regular operation, the Power Distribution System (PDS) is secured by fuse F8 and phase two is set by relay **K4**, which is operated by the control signal voltage, **GAN_TI**, **2**.

The two supply lines for the Patient Handling System (PHS) are protected in the PDS with fuses F15 and F16 inside the PDC unit.

S1

For service purposes, the S1 service switch of the PDS can power up the Patient Table. This switch bypasses relay **K4** and allows the Patient Table operation, even when the unit is switched OFF.

Gantry Stationary

The Patient Handling System (PHS) receives two lines (L_PHS1, L_PHS2) with 230 VAC, derived from phase two of the PDS. Both power lines pass through the Power Supply Stationary (PSS) of the Gantry Stationary and run to the PHS via the cable duct on the floor.

Stop Relay

The 230 VAC line passes line filter **Z702** and then solid state stop relay **D703**, where it can be interrupted by the system stop circuit in emergency cases.

Frequency Converter

The **E702** frequency converter generates three AC supply phases (U, V, and W) for the spindle motor from a single input phase, as defined by its parameters.

PT_PWR

The **G700** Patient Table DC power supply (**PT_PWR**) generates the low voltages of 5 V, 12 V and 24 V that are required for horizontal and vertical movement on boards **D701** and **D702**, and for the clutch, sensors, encoders, switches and brakes.

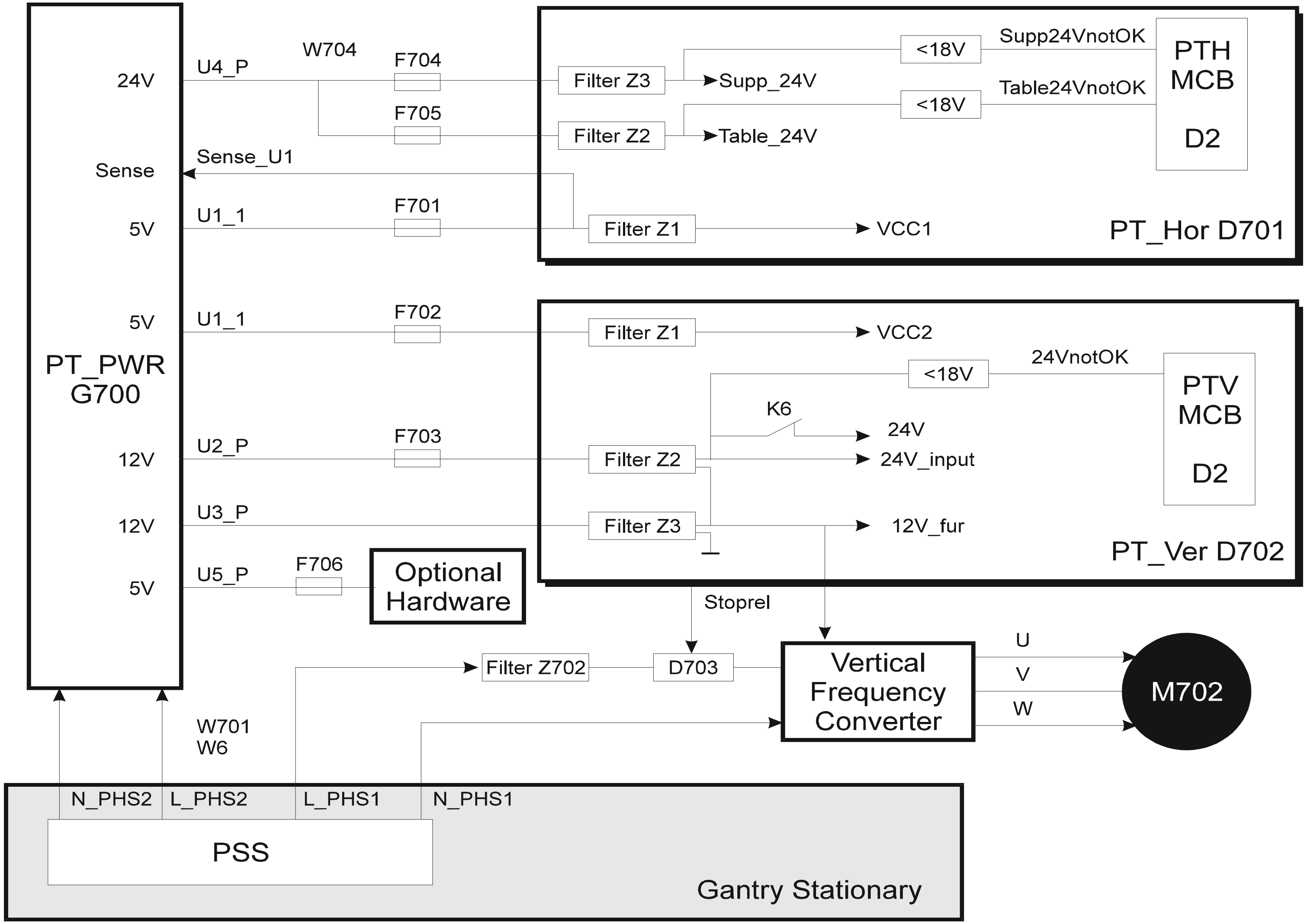

PT_PWR
G700
24V
Sense
5V
5V
12V
12V
5V
U4_P
W704
F704
F705
Sense_U1
U1_1
F701
U1_1
F702
U2_P
F703
U3_P
U5_P
F706
Filter Z3
Supp_24V
Filter Z2
Table_24V
<18V
Supp24VnotOK
<18V
Table24VnotOK
PTH
MCB
D2
Filter Z1
VCC1
PT_Hor D701
Filter Z1
VCC2
<18V
24VnotOK
PTV
MCB
D2
K6
24V
Filter Z2
24V_input
Filter Z3
12V_fur
PT_Ver D702
Optional
Hardware
Stoprel
Filter Z702
D703
Vertical
Frequency
Converter
U
V
W
M702
W701
W6
N_PHS2
L_PHS2
L_PHS1
N_PHS1
PSS
Gantry Stationary

Figure 5-9: Patient Handling System (PHS), Power Supply

PT_Hor

The Patient Table Horizontal (**PT_Hor**) board gets one 5 V (**U1_1**) and two 24 V supplies (**U4_P**) from the power supply, through fuses. On the board, all supply voltages pass line filters to reduce line disturbances. **PT_Hor** also supplies the sense signal to the power supply for voltage regulation.

PT_Ver

The Patient Table Vertical (**PT_Ver**) board gets one 5 V (**U1_2**) and two 12 V supplies (**U2_P**, **U3_P**). They all pass line filters on the board to protect them against disturbances. Both 12 V supplies are connected to a cascade to raise the total voltage to 24 V.

Power Supply Signals

LPHS1	In the PHS, one power phase (**LPHS1**), with the frequency converter, drives the **M702** spindle motor of the vertical drive.
LPHS2	The second power line (**LPHS2**) supplies the G700 Patient Table DC power supply (**PT_PWR**), which generates all low voltage used on the horizontal and the vertical control boards.
VCC 2	This 5 V supply for the Patient Table Vertical (**PT_Ver**) board is generated from a common source in **PT_PWR** (connected via fuse **F702**).
VCC 1	This 5 V supply for the Patient Table Horizontal (**PT_Hor**) board is generated from a common source in **PT_PWR** (connected via fuse **F701**). It is also used to generate the sense signal for the voltage regulation.
Table_24V	This 24 V supply is used for the tabletop motor drive (connected via fuse **F705**).
Supp_24V	This 24 V supply is used for the top motor drive (connected via fuse **F704**).
Supp24VnotOK	The 24 V supplies for the top support motor are monitored by the PTH function controller. If the voltage drops below 18 V, the **Supp24VnotOk** signal is issued as a warning.
Table24VnotOk	The 24 V supplies for the table top motor are monitored by the PTH function controller. If the voltage drops below 18 V, the **Supp24VnotOk** signal is issued as a warning.
24V_input	The **24V_input** signal is a continuous control supply for internal switches and current loops. Both 12 V supplies are connected to a cascade to raise them to a total voltage of 24 V.
24V	The **24 V** line is a switched supply for the brakes. It is enabled by the stop and service logic, with relay **K6**. Both 12 V supplies are connected to a cascade to raise them to a total voltage of 24 V.

24VnotOk	The **24 V** signals are monitored by the PTV function controller. If the voltage drops below 18 V, the signal **24VnotOk** is issued as a warning.
12V_FUR	A 12 V line that supplies the frequency converter with its internal operating voltage **12V_fur**.

Parts Replacement

Removing Table Covers

Read these instructions completely prior to beginning the replacement of the Table Covers. Follow all procedures for removing and installing the table covers.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in the instructions in this chapter.

Tighten the screws and nuts using the torque indicated in these instructions and secure them with Loctite™ when required.

Secure cables with cable ties and/or cable clamps as indicated and ensure that they are connected according to the original configuration.

⚠ CAUTION

PRINTED CIRCUIT BOARDS MUST BE REPLACED IF COMPONENTS SOLDERED ONTO THE BOARD (INCLUDING FUSES) ARE DEFECTIVE.

Required Tools and Auxiliary Materials

Standard FSE toolkit.

Procedure

Remove the covers as follows:

1. Bring the Patient Table to a height of 800 mm.
1. Remove the lower cover (*Figure 5-11*), located directly behind the bellows.
2. Remove the side covers:
   a. Remove the M4 Decorative Screws on each side of the Patient Table (*Figure 5-12*).
   b. Pull the side cover out and then down releasing the four upper pins (*Figure 5-13*).

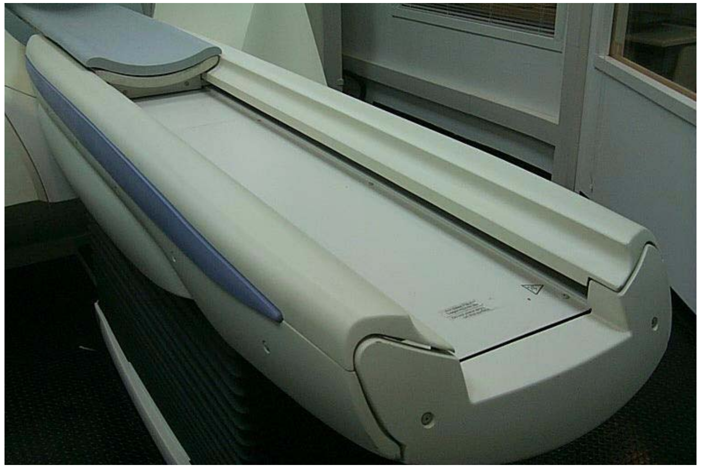


Figure 5-10: Table Covers

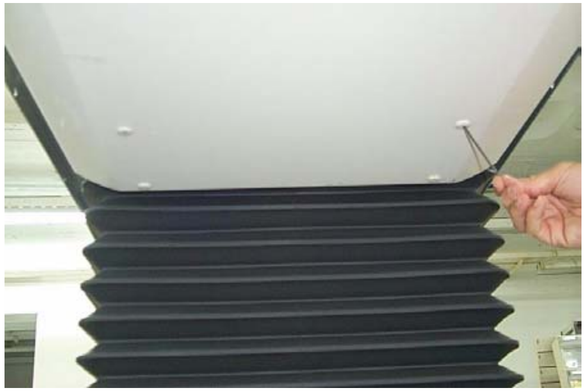


Figure 5-11: Lower Cover

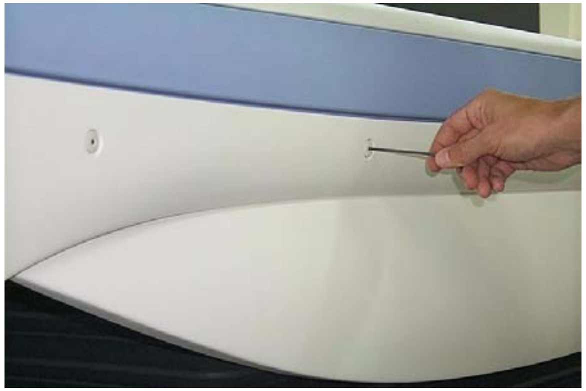


Figure 5-12: Side Cover decorative screws

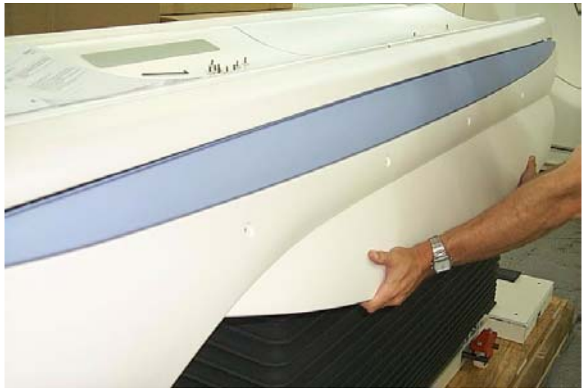


Figure 5-13: Removing Side Cover

3. Remove the inside cover by removing the four M4 Decorative Screws (1 in *Figure 5-14*).
4. Loosen both screws (2 in *Figure 5-14*) and push the support toward the front.
5. Remove the three upper lateral covers (*Figure 5-15*)
6. Remove the screws from the upper guide rails (*Figure 5-16*). Raise the table if necessary.
7. Remove the bellows.

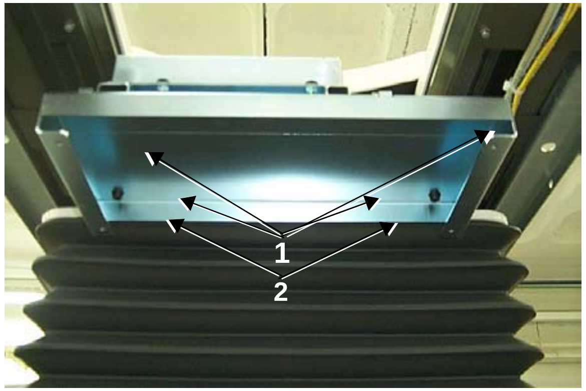


Figure 5-14: Inside Cover Screws

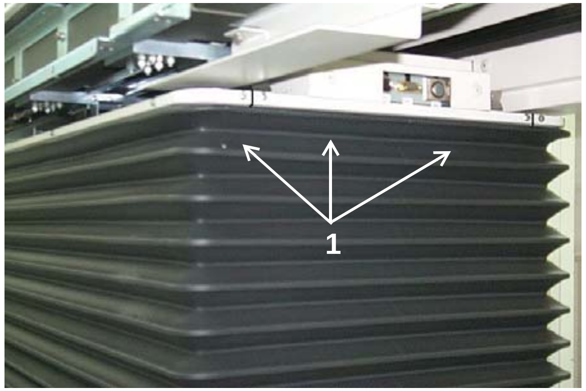


Figure 5-15: Three Upper Lateral Covers

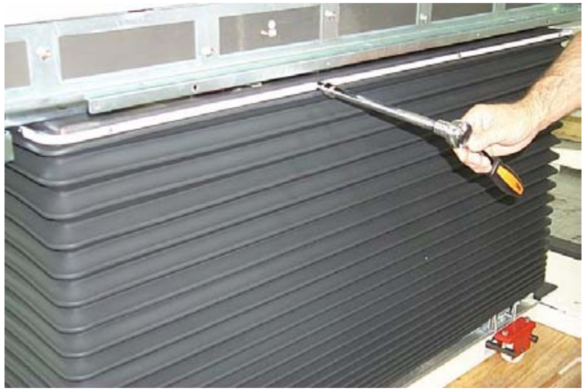


Figure 5-16: Removing Screws from Upper Guide Rails

Bellows/Vertical Electronics (D702)

Move the table to a comfortable work position between 800 and 1,000 mm (317 to 117 at the Gantry panels) using the corresponding keys on the Gantry operating panel or the service key on the table.

If movement of the table is not possible due to a table malfunction, use the manual table height adjustment nut on the motor block (Replacement of Parts/Table Lift Motor (*Figure 5-25*). If it is not possible to move the table via the manual table height adjustment nut, cut the bellows into two pieces with an appropriate tool and remove them.

NOTE:

When replacing parts in the Patient Table, remove the bellows from the upper guide rails.

When using the manual table height adjustment nut, do not raise the table higher than 1,000 mm (117 at the Gantry panels).

Tabletop/Horizontal Electronics (D701)

Move the table to a comfortable work position between 800 and 1,000 mm (317 to 117 at the Gantry panels) using the corresponding keys on the Gantry operating panel or the service key on the table.

Securing the Bellows to the Patient Table Frame

Examine the accessories for securing the bellows (see *Table 5-1* and *Figure 5-17*).

Table 5-1: Accessories for Securing the Bellows

ITEM	DESCRIPTION	QTY
1	Hex screws	10
2	Long metal strip	2
3	Short metal strip	2

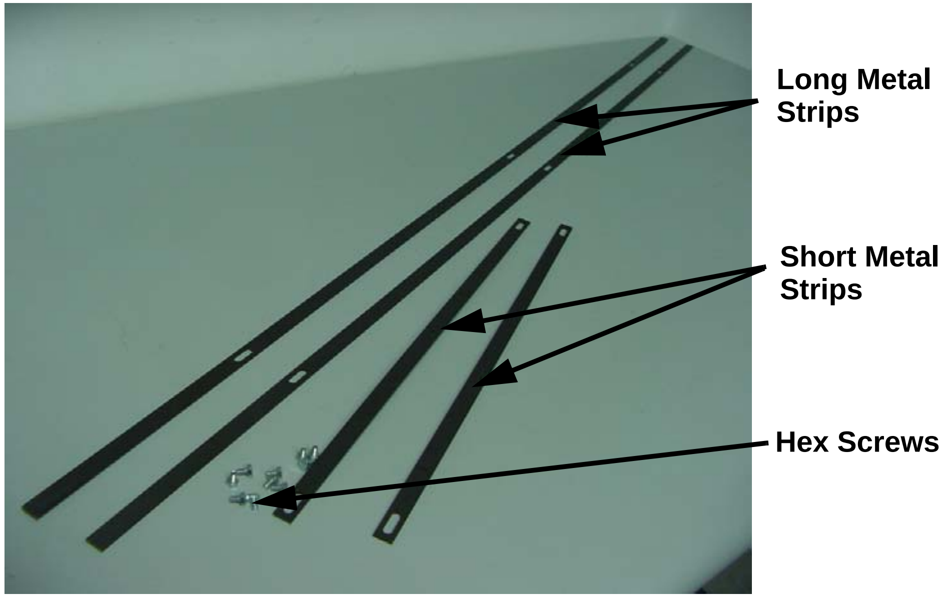


Figure 5-17: Accessories for Securing the Bellows

Tools

- Standard FSE tool kit
- Plastic hammer

Preparation

1. Raise the Patient Table to a height of 100 cm (40") approx. (117 on the Gantry panel).
2. Locate the holes on the bottom of the aluminium guide rails. The holes are not readily visible. Slide a finger along the underside of the rail to locate them (see *Figure 5-18* and *Figure 5-19*).
3. Insert a hex screw into the hole, and tighten slightly by hand. Ensure that the screw can be inserted completely.
4. Loosen the hex screw so that it **does not protrude above the bottom body of the guide rail** (see *Figure 5-19*).
5. Repeat steps 3-4 for the nine remaining hex screws in all four guide rails.

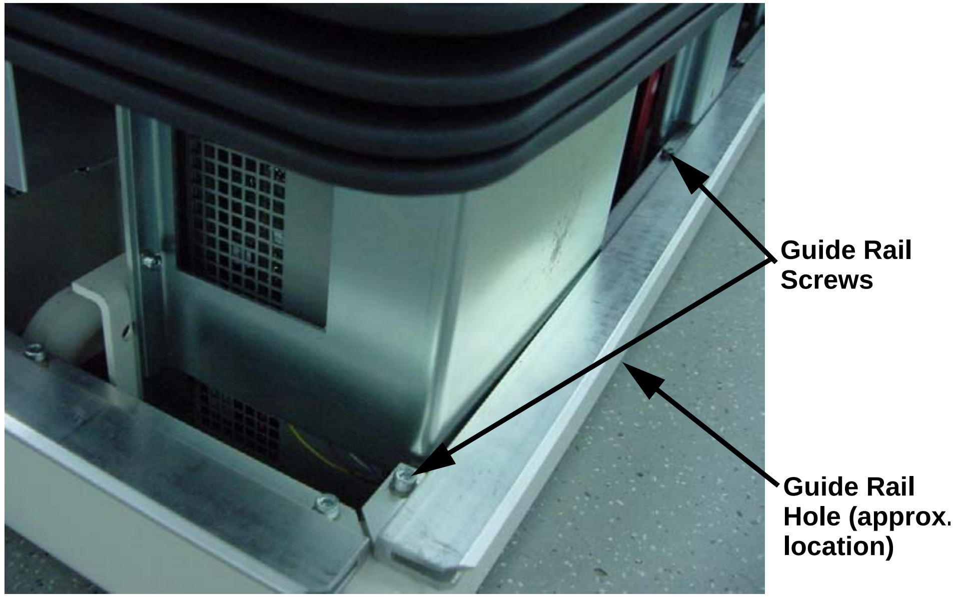


Figure 5-18: Aluminum Guide Rails

> **NOTE:**
>
> If a hex screw cannot be completely inserted, loosen some corresponding screws securing the guide rail to the Patient Table frame (see *Figure 5-18*).
>
> Pull the guide rail out as far as possible, and tighten the guide rail screws.

Main Procedure

1. Insert the bellows into the four guide rails around the Patient Table frame (see *Figure 5-19*).

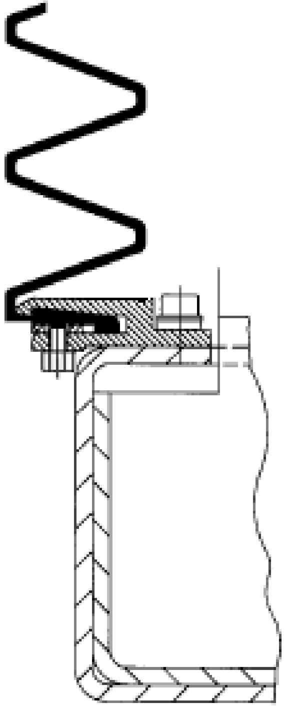


Figure 5-19: Attaching Bellows to Patient Table Frame

NOTE:

Ensure that the bellows are fully inserted into the guide rails all around the Patient Table.

If not fully inserted, you will not be able to perform the next step.

2. Position one of the four metal strips (see *Figure 5-20* and *Figure 5-21*) along the appropriate long or short guide rail, so that the metal strip holes are opposite the previously inserted hex screws.

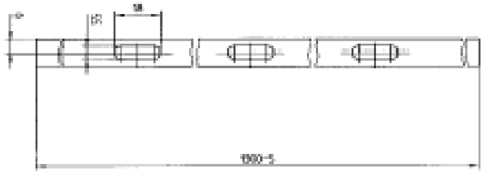


Figure 5-20: Long Metal Strip

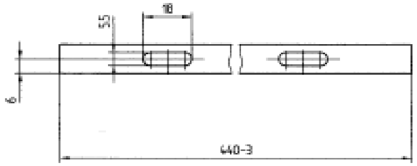


Figure 5-21: Short Metal Strip

3. Slightly tilt the metal strip with the outer edge down, and gently insert one end of the strip into the guide rail slot below the bellows. (Move the outer edge of the strip up and down to facilitate entry) (see *Figure 5-22*).

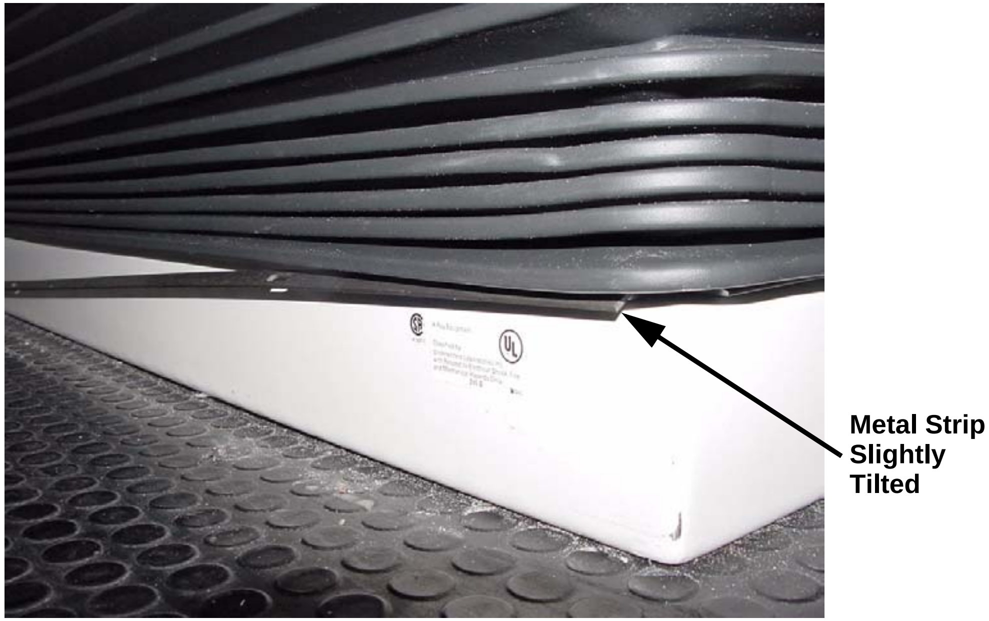


Figure 5-22: Tilt the Metal Strip

4. Use the plastic hammer to gently insert the end of the metal strip into the guide rail slot.
5. Tighten the corresponding hex screw to secure the end of the metal strip in place.
6. Use the plastic hammer to gently insert the remaining metal strip into the guide rail slot, and tighten the remaining hex screws.
7. Repeat steps 2-6 for the three remaining metal strips.

Installing the Covers

1. Install the covers, proceeding in the reverse order of the previous removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

Tests and Adjustments

1. Ensure that the covers are attached and seated correctly.
2. Test all possible table movements.

Table Lift Motor

Read these instructions completely prior to beginning the replacement of the motor.

Follow all procedures for removing and installing the Table Lift Motor.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *"Safety Guidelines" on page 1-1*.

Note the special safety guidelines indicated in these instructions.

Tighten the screws and nuts using the torque indicated in these instructions and secure them with Loctite™ if required.

Secure cables with cable ties and/or cable clamps and ensure that they match their original status.

If the table lift movement is blocked because of a mechanical problem of the safety catch (part of the spindle-nut), the complete Table Lift Motor has to be replaced.

⚠ WARNING

FOR CONTINUED PROTECTION AGAINST PERSONAL INJURY; REPAIR OR REPLACE THE SAFETY CATCH (OR SPECIFIC RESTRAINING MEANS, AS APPROPRIATE) AFTER IT HAS BEEN ACTIVATED. REFER TO INSTRUCTIONS IN THE SERVICE MANUAL PROVIDED WITH THE EQUIPMENT.

Required Tools and Auxiliary Materials

- Service tool set
- Special (circlip) pliers for locking rings
- Two blocks of wood (680 mm long/4 x 60 mm) (26.8 inches long/4 x 2.4 inches)
- Loctite™ 242

Preliminary Steps

1. Remove the table cover (refer to *“Removing Table Covers” on page 5-30*).
2. Raise or lower the Patient Table as needed.
3. Support the tabletop with the two blocks of wood (1 in *Figure 5-23*).
4. Lower the tabletop onto the blocks of wood until Connect Switch S704 (1 in *Figure 5-24*) at the spindle nut (2 in *Figure 5-24*) has responded.
5. To do so, use the keys on the Gantry operating panels, the Service-Switches S701-703 at the table base or the manual table height adjustment nut on the motor block (1 in *Figure 5-25*).
6. Switch OFF the system.

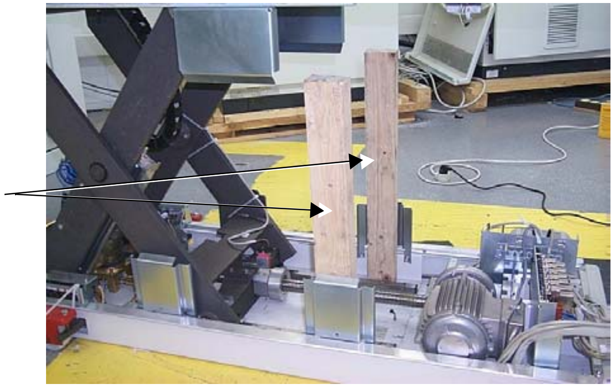


Figure 5-23: Patient Table—Blocks of Wood

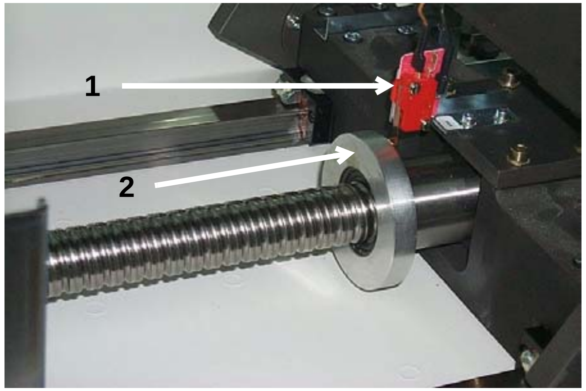


Figure 5-24: Spindle Nut S704

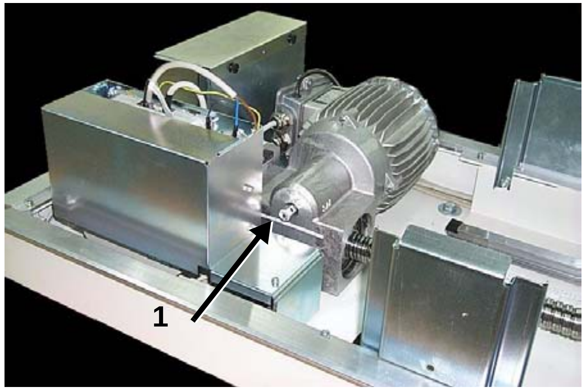


Figure 5-25: Table Lift Motor—Manual Table Height Adjustment Nut

Removing the Table Lift Motor

To remove the Table Lift Motor:

1. Remove the nuts of the board (1 in *Figure 5-26*).
2. Place the entire board including the metal housing and the connectors next to the table.
3. Remove the cover from the electrical connections for the motor (*Figure 5-27*).
4. Remove the cable.
5. Remove the cover including S704 from the spindle nut and put it aside (1 in *Figure 5-24*).
6. Remove the locking ring and the washer (1 in *Figure 5-30*) with the special (circlip) pliers.
7. Remove both screws from the spindle brake block (*Figure 5-29*).
8. Remove both screws of the stopper (*Figure 5-29*) and remove both parts of it from the spindle.
9. Remove the brake from the spindle.

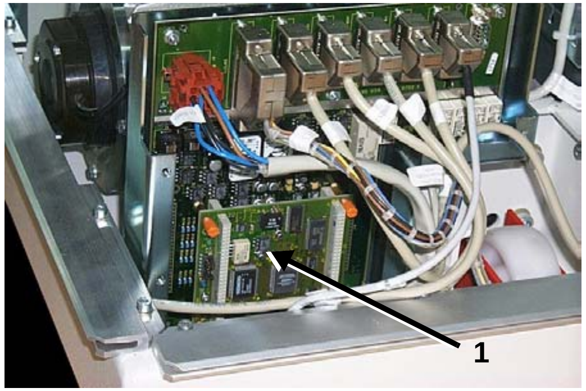


Figure 5-26: PT Vertical Board D702

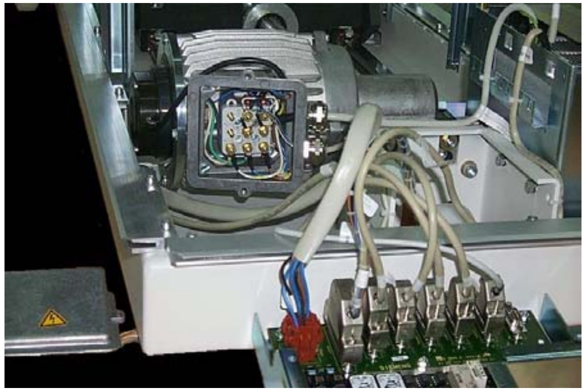


Figure 5-27: Table Lift Motor

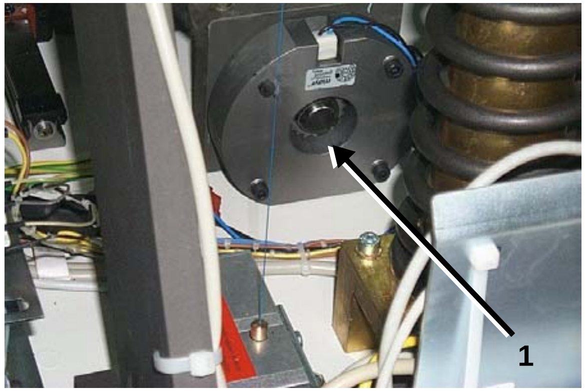


Figure 5-28: Spindle Brakes

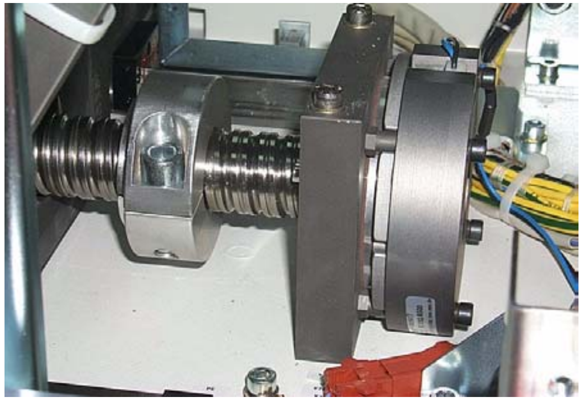


Figure 5-29: Spindle brake

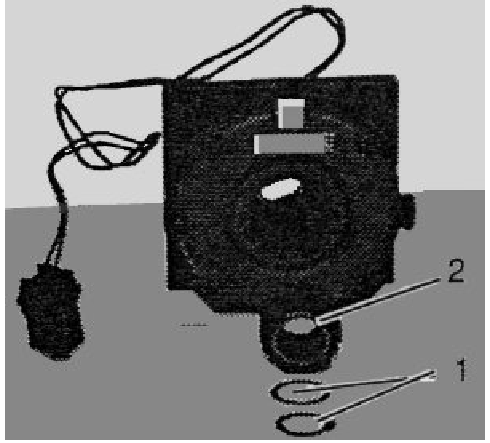


Figure 5-30: Spindle brake, toothed gear, washers

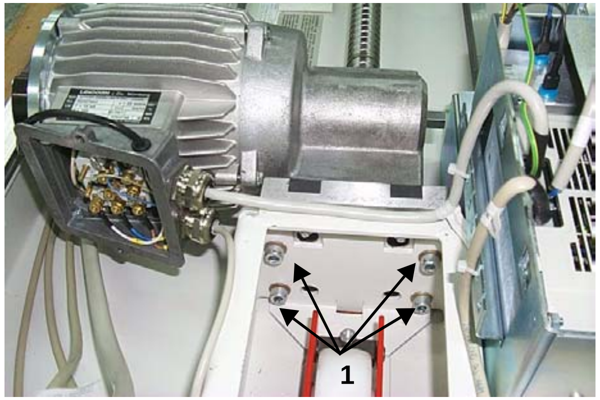


Figure 5-31: Screws securing the Table Lift Motor

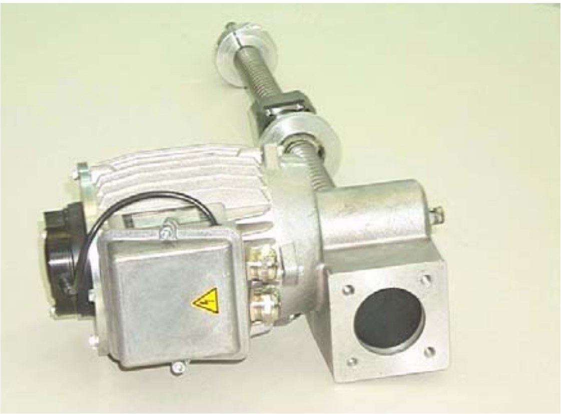


Figure 5-32: Table Lift Motor—Mounting Block

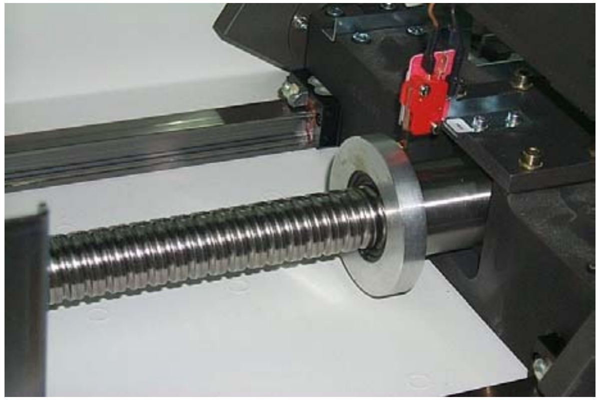


Figure 5-33: Spindle Nut

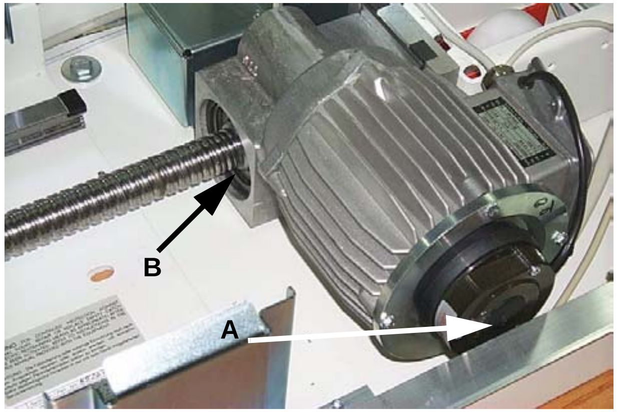


Figure 5-34: Table Lift Motor

To remove the Table Lift Motor:

1. Remove the nuts of the board (1 in *Figure 5-26*).
2. Place the entire board including the metal housing and the connectors next to the table.
3. Remove the cover from the electrical connections for the motor (*Figure 5-27*).
4. Remove the cable.
5. Remove the cover including S704 from the spindle nut and put it aside (1 in *Figure 5-24*).
6. Remove the locking ring and the washer (1 in *Figure 5-30*) with the special (circlip) pliers.
7. Remove both screws from the spindle brake block (*Figure 5-29*).
8. Remove both screws of the stopper (*Figure 5-29*) and remove both parts of it from the spindle.
9. Remove the brake from the spindle.

NOTE:

If the toothed gear (2 in *Figure 5-30*) falls out of the brake when the spindle brake is removed, install it with the writing and arrow facing the spindle (arrow in counterclockwise).

1. Remove the four screws from the motor bracket (1 in *Figure 5-31*).
2. Lift the motor out, together with the spindle and the spindle nut.

Installing the Table Lift Motor

NOTE:

Do not remove the nut from the spindle.

To install the Table Lift Motor:

1. Remove the square block from the old motor (*Figure 5-32*).
2. Ensure that square block at the new motor is positioned correctly. Attach it with the appropriate screws and secure them with Loctite™ 242 (according to the manufacturer's instructions).
3. Turn the spindle nut so that it is in position A (*Figure 5-34*) when the motor is installed.
4. Ensure that the spindle nut is in the correct position when installing the new motor.
5. The connections for Connect Switch S704 must face in the direction indicated in *Figure 5-27*.

NOTE:

After placing the motor and before attaching the motor block, raise the motor at point A until the motor block is flat on the table base at point B (*Figure 5-34*).

This Is necessary to ensure that the motor axle is perfectly horizontal.

Tighten the screws after the motor block is aligned properly (*Figure 5-31*).

When installing the new table lift motor, proceed in the reverse order of the removal procedure (Removing the Table Lift Motor).

Attach both parts of the stopper with the corresponding screws approximately at the place of the spindle where it was before removing.

Test and Adjustments

1. Check the position of the Patient Table with the PAT/POS test.
2. Adjustment of S704:
   a. Raise the table until the blocks of wood (1 in *Figure 5-23*) are free again.
   b. Measure the distance “x” as shown in the following drawing (see *Figure 5-35*).
   c. Lower the table top onto the blocks of wood until the distance x is x + 2 mm (± 0.5 mm) (see *“Required Tools and Auxiliary Materials” on page 5-41*).
   d. Adjust S704 at this point. The contacts must be slightly open.
3. Adjustment of the stopper:
   a. Raise the table to the end position of 1031 ± 3 mm.
   b. Turn the stopper until it hits point A shown in the drawing (see *Figure 5-36*).
4. Tighten both screws of the stopper using 69 Nm (± 5%) torque.

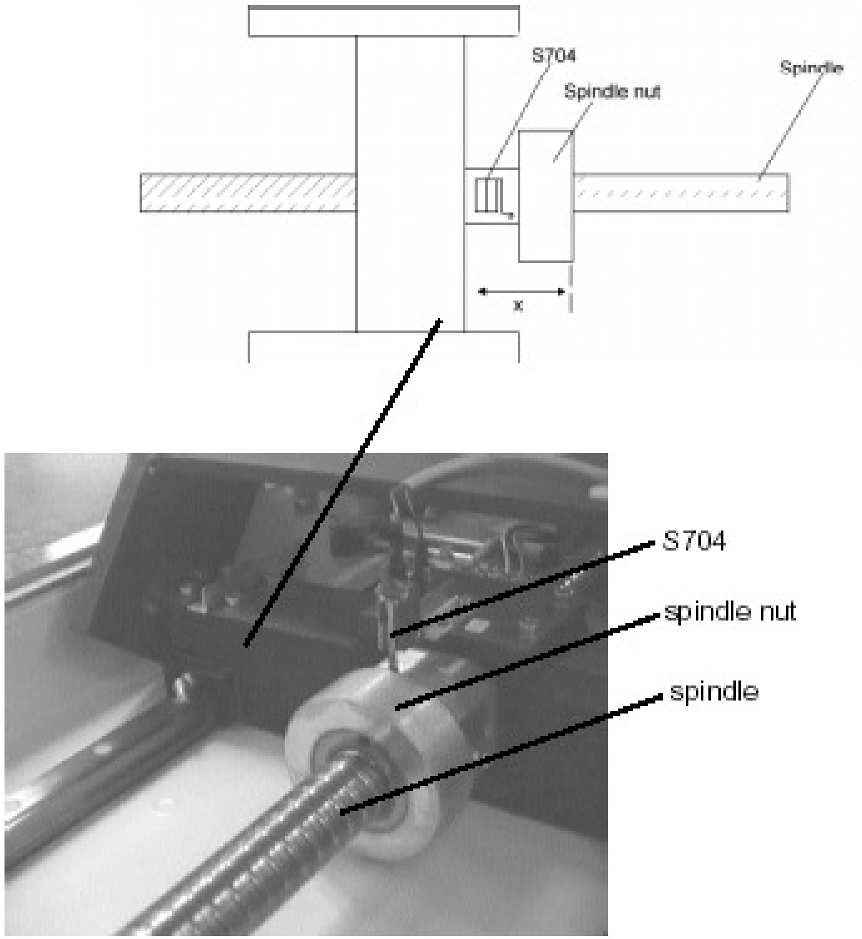


Figure 5-35:

Final Steps

1. Remove the blocks of wood.
2. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
3. Connect the protective conductors as needed (ground).

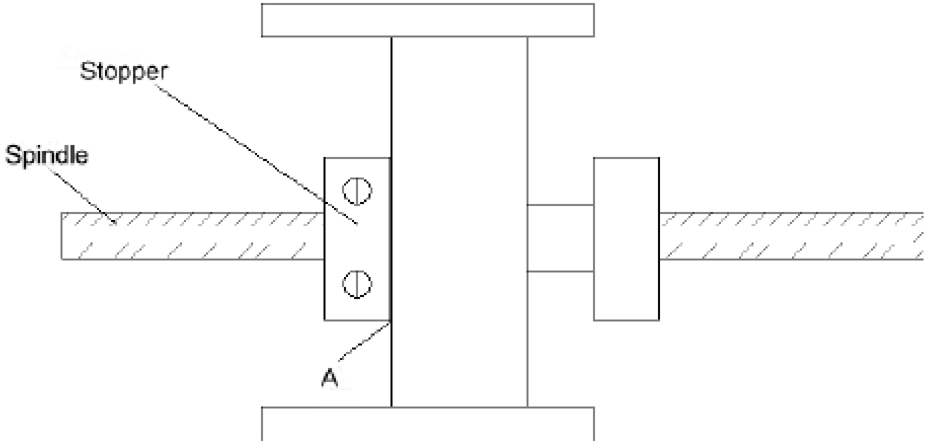


Figure 5-36:

Inverter for the Table Lift Motor

Read these instructions completely prior to beginning the replacement of the inverter.

Follow all procedures for removing and installing the Table Lift Motor.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in these instructions in this chapter.

Tighten the screws and nuts using the torque specifically indicated in these instructions. Secure them with Loctite™ when required.

Secure cables with cable ties and/or cable clamps and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

Service tool set

Preliminary Steps

1. Remove the table cover according to the instructions, *“Removing Table Covers” on page 5-30*.
2. Raise the Patient Table as needed to replace the part.
3. Power OFF the system by turning Switch F1 in the PDC OFF.

Removing the Inverter for the Table Lift Motor

To remove the inverter for the Table Lift Motor:

1. Remove three screws (1 in *Figure 5-37* and 1 in *Figure 5-38*) from the board cover.
2. Remove three nuts from the assembly stand of the inverter (2 in *Figure 5-37* and *Figure 5-39*).
3. Remove the cover from the inverter (*Figure 5-39*).
4. Disconnect the cables from the inverter (*Figure 5-39*).
5. Remove the four nuts from the inverter.

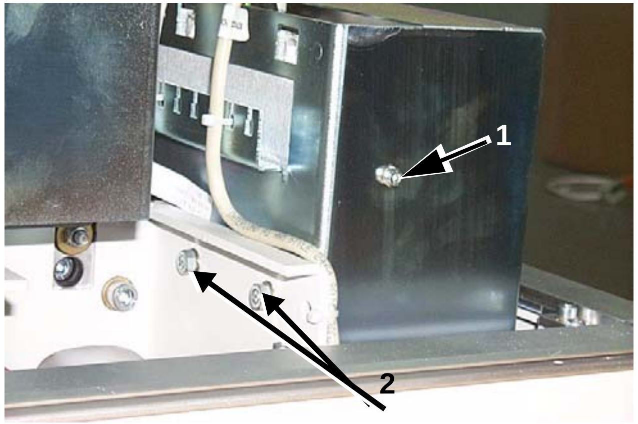


Figure 5-37:

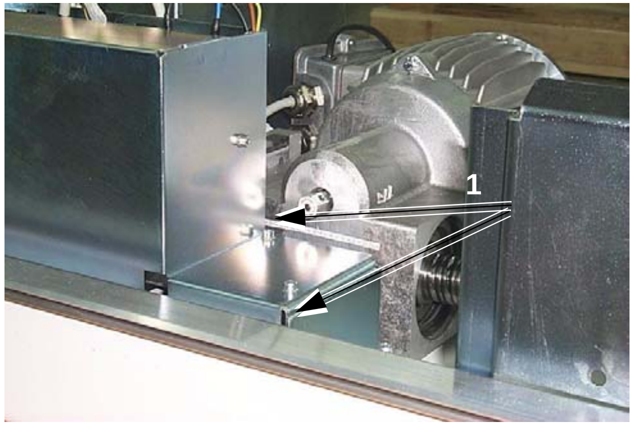


Figure 5-38:

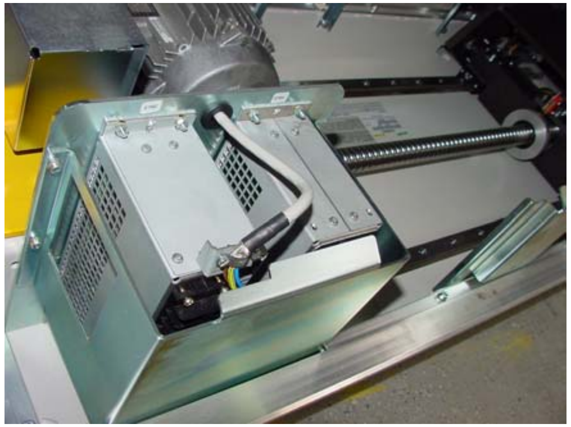


Figure 5-39:

Installing the Inverter for the Table Lift Motor

Install the new inverter for the Table Lift Motor, proceeding in the reverse order of the previous procedure (Removing the Inverter for the Table Lift Motor).

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).
3. Switch system power ON. Wait until the system comes reaches Stand-by state.
4. Check the vertical movement of the table with the function (UP/DOWN) buttons from the Gantry or the CT Box.

PT Vertical Board

Read these instructions completely prior to beginning the replacement. Follow all procedures for removing and installing the PT Vertical Board. Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *"Safety Guidelines" on page 1-1*.

Note the special safety guidelines indicated in this chapter.

Tighten the screws and nuts using the torque indicated in these instructions. Secure them with Loctite when required.

Secure cables with cable ties and/or cable clamps and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

Service tool set

Preliminary Steps

1. Remove the table covers according to the instructions, *"Removing Table Covers" on page 5-30*.
2. Raise the table as needed to replace the part.
3. Power OFF the system by turning Switch F1 in the PDC OFF.

Removing the PT Vertical Board

To remove the PT Vertical Board:

1. Remove the cover of the connectors (2 screws).
2. Remove the cover of the board (4 screws).
3. Remove the five screws (1 in *Figure 5-40*).
4. Disconnect connectors Xl, X2, X3, X5.
5. Remove the defective board.

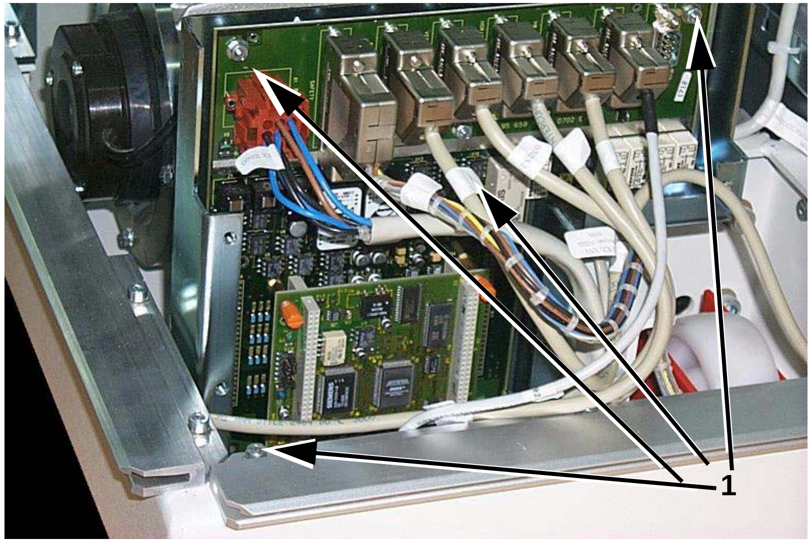


Figure 5-40:

Installing the PT Vertical Board

1. If a MCB is not installed on the new PT Vertical Board, remove the MCB from the defective PT Vertical Board and install it on the new PT Vertical Board.
2. Install the new PT Vertical Board by performing the previous procedure in the reverse order (Removing the PT Vertical Board).
3. If you install a new MCB, you must load the appropriate firmware for the current software version.

Tests and Adjustments

Perform the PTV Adjustment procedure (described in Section *"Patient Table Vertical (PTV) Adjustment"*).

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

Connect Switch S704

Read these instructions completely prior to beginning the replacement of the switch.

Follow all procedures for removing and installing the safety switches.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in this chapter.

Tighten the screws and nuts using the torque specifically indicated in these instructions. Secure them with Loctite when required.

Secure cables with cable ties and/or cable clamps and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

- Service tool set

Preliminary Steps

1. Remove the table covers according to the instructions, *“Removing Table Covers” on page 5-30*.
2. Raise the Patient Table as needed to replace the part.
3. Power OFF the system by turning Switch F1 in the PDC OFF.

Removing Connect Switch S704

To remove Spindle Connect Switch S704 (1 in *Figure 5-41*):

1. Disconnect both cables from contacts “NO and COM.”
2. Remove the two screws from the bracket for S704 (1 in *Figure 5-41*).
3. Remove the switch.

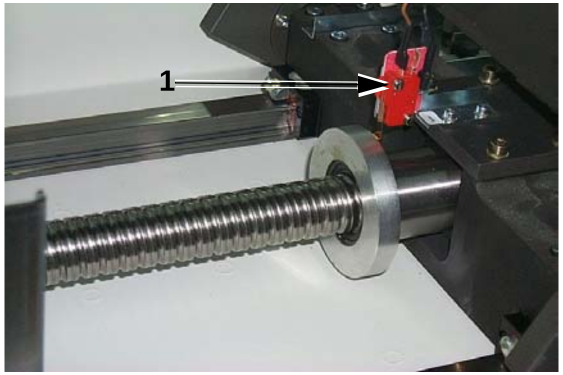


Figure 5-41: Connect Switch S704

Installing Connect Switch S704

1. Install the Connect Switch on the bracket.
2. Connect both cables to contacts NO and COM.
3. Attach the switch loosely with both screws, so that it is not activated.
4. Press the appropriate key on the gantry operating panel to lower the patient table. Vertical table movement must be blocked.
5. Secure the switch and bracket so that they makes contact with the spindle nut and is pressed, i.e., the switch is closed.

It must be possible to lower the patient table.

Tests and Adjustments

- Test the vertical movement of the patient table using the corresponding keys on the Gantry operating panel.
- Test the reaction of S704 when movement of the tabletop scissors is obstructed. Refer to the instructions for the “Table Lift Motor” (*Figure 5-42*).

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

Spindle Brake

Read these instructions completely prior to beginning the replacement of the brake.

Follow all procedures for removing and installing the Spindle Brake.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in these instructions in this chapter.

Tighten the screws and nuts using the torque indicated in these instructions. Secure them with Loctite when required.

Secure cables with cable ties and/or cable clamps and ensure that they match their original status.

Required Tools and Auxiliary Materials

- Service tool set
- Special (circlip) pliers for locking rings
- Two blocks of wood (680 mm long/4 x 60 mm) (26.8 inches long/4 x 2.4 inches)

Preliminary Steps

1. Remove the table covers according to the instructions, *“Removing Table Covers” on page 5-30*.
2. Move the table to a comfortable work height.
3. Use the two blocks of wood to support the tabletop (1 in *Figure 5-42*)
4. Lower the tabletop onto the blocks of wood until Connect Switch S704 (1 in *Figure 5-43*) is activated by the spindle nut (2 in *Figure 5-43*). Use the appropriate keys on the Gantry operating panel or the nut on the motor block reserved for emergencies (1 in *Figure 5-44*) to lower the tabletop.
5. Power OFF the system by turning Switch F1 in the PDC OFF.

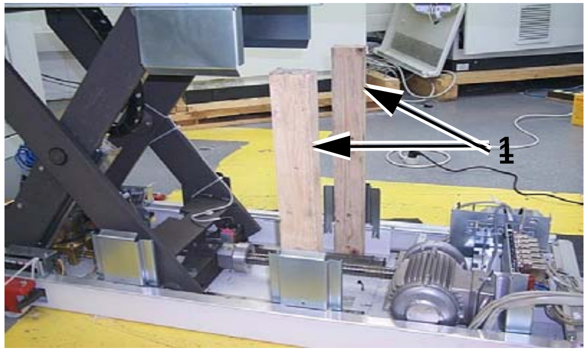


Figure 5-42: Patient Table-Blocks of Wood

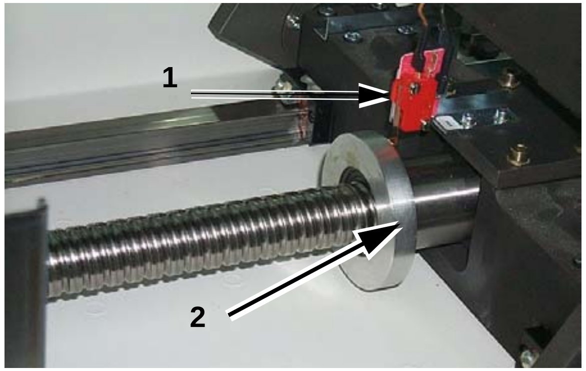


Figure 5-43: Connect Switch S704

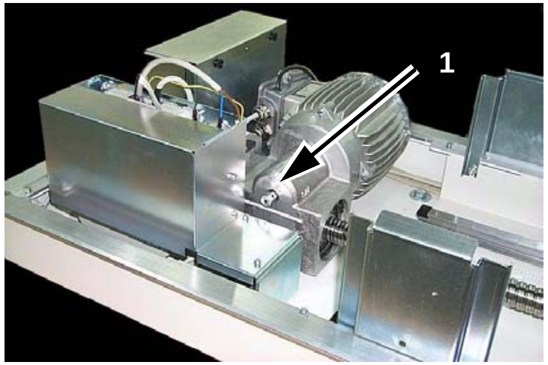


Figure 5-44: Table Lift Motor-manual table height adjustment nut

Removing the Spindle Brake

To remove the Spindle Brake:

1. Remove the locking ring and washer (l in *Figure 5-47*)with the special (circlip) pliers.
2. Remove four screws from the Spindle Brake (l in *Figure 5-46*).
3. Remove the brake from the spindle.
4. Disconnect connector Y702. Xl (not at the brake).

NOTE:

If the toothed gear (2 in *Figure 5-47*) falls out when the Spindle Brake is removed, install it with the writing and the arrow facing the spindle (arrow facing in counterclockwise).

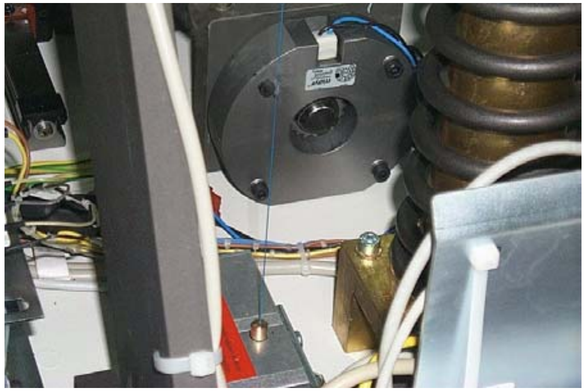


Figure 5-45: Spindle Brake

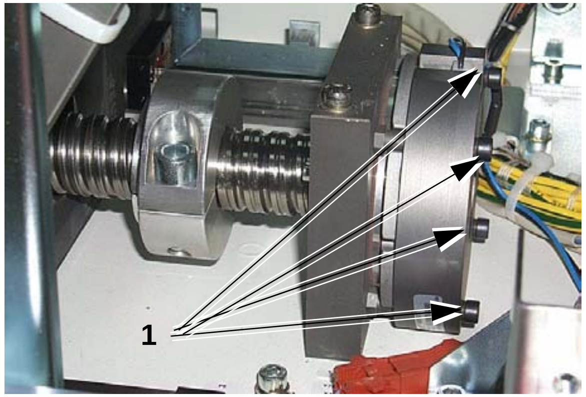


Figure 5-46: Spindle Brake

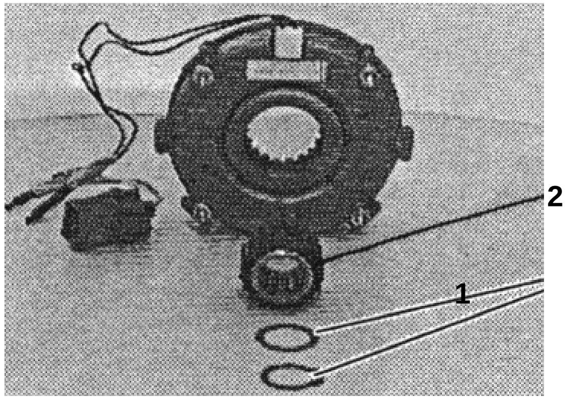


Figure 5-47: Spindle Brake-toothed gear, locking ring and washer

Installing the Spindle Brake

Install the new Spindle Brake (Section *"Removing the Spindle Brake"*) by performing the previous procedure in the reverse order.

Tests and Adjustments

1. Raise the table to the highest position.

2. Remove the blocks of wood.
3. Check the vertical movement of the Patient Table using the appropriate keys on the Gantry operating panel.

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

Vertical Position Potentiometer

Read these instructions completely prior to beginning the replacement of the Potentiometer.

Follow all procedures for removing and installing the encoder, the vertical position tape hitch.

Follow Electrostatic Sensitive Devices (ESD) guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in the instructions in this chapter.

Tighten the screws and nuts using the torque specifically indicated in these instructions. Secure them with Loctite when required.

Secure cables with cable ties and/or cable clamps and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

Service tool set

Preliminary Steps

1. Remove the table covers according to the instructions, *“Removing Table Covers” on page 5-30*.
2. Power OFF the system by turning Switch F1 in the PDC OFF.

Removing the Vertical Position Potentiometer B702

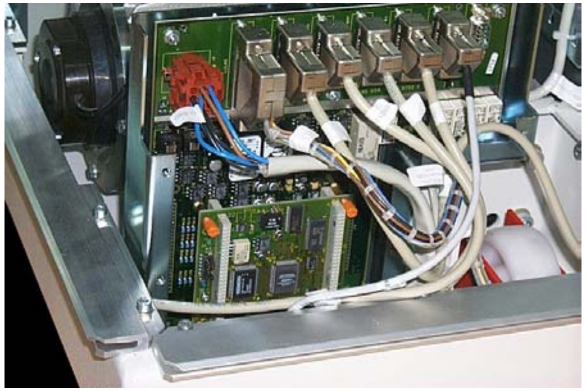


Figure 5-48: PT Vertical Board D702

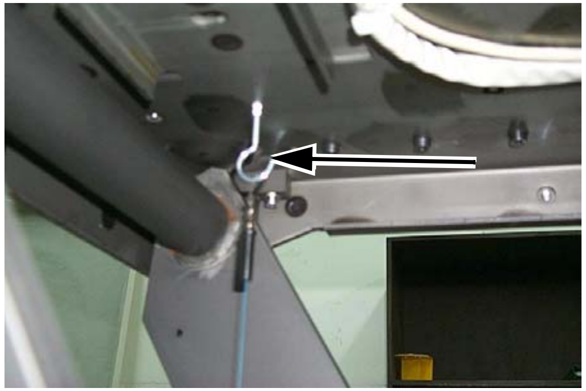


Figure 5-49: Vertical Position tape hitch

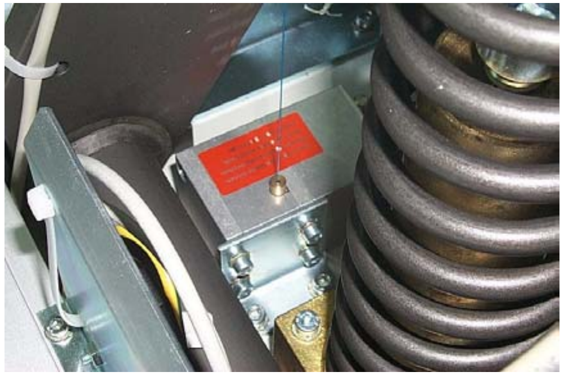


Figure 5-50: Potentiometer

⚠ WARNING

THE VERTICAL POSITION TAPE HITCH IS SPRING-LOADED. DO NOT ALLOW IT TO SNAP.

To Remove the Vertical Position Potentiometer:

1. Disconnect connector X5 from PT vertical board D702 (*Figure 5-48*)
2. Remove the vertical position tape hitch from the hook on the underside of the tabletop (1 in *Figure 5-49*).
3. Remove the two screws.
4. Remove the vertical position Potentiometer with the holder.
5. Remove the holder and attach it at the new Potentiometer.

Installing the Vertical Position Potentiometer

Install the new vertical position Potentiometer, proceeding in the reverse order of the previous procedure (Removing the Vertical Position Potentiometer).

Tests and Adjustments

1. Check the vertical movement of the Patient Table using the appropriate keys on the Gantry operating panel.
2. After the encoder is replaced, test and adjust the table height using the “PAT POS” test.
3. Perform the PTV adjustment procedure (described in Section *"Patient Table Vertical (PTV) Adjustment"*).

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

Horizontal Tabletop Motor

Read these instructions completely prior to beginning the replacement of the motor.

Follow all procedures for removing and installing the Horizontal Tabletop Motor.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in the instructions in this chapter.

Tighten the screws and nuts using the torque indicated in these instructions. Secure them with Loctite when required.

Secure cables with cable ties and/or cable clamps and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

- Service tool set
- Loctite 242

Preliminary Steps

1. Remove the table covers according to the instructions, *"Removing Table Covers" on page 5-30*.
2. Power OFF the system by turning Switch F1 in the PDC OFF.
3. Remove the three screws from the cover (see *Figure 5-51*).
4. Additionally, there are five screws to remove to avoid damage during the lifting of this cover (at a later stage).

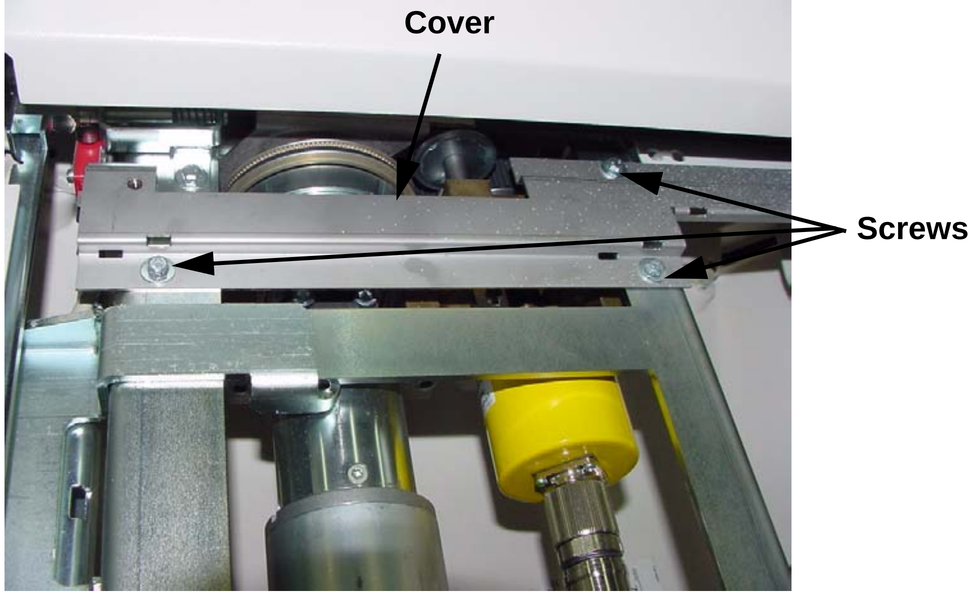


Figure 5-51: Horizontal Tabletop Motor Cover

Removing the Horizontal Tabletop Motor

To remove the Horizontal Tabletop Motor:

1. Lift this part of the cover slightly to allow both screws to be removed from the axle (1 in *Figure 5-52*).
2. Disconnect connector M71 1/Xl and remove all cable ties.
3. Remove both screws that hold the motor in place (see *Figure 5-53*).
4. Remove four screws from the assembly stand of the old motor.

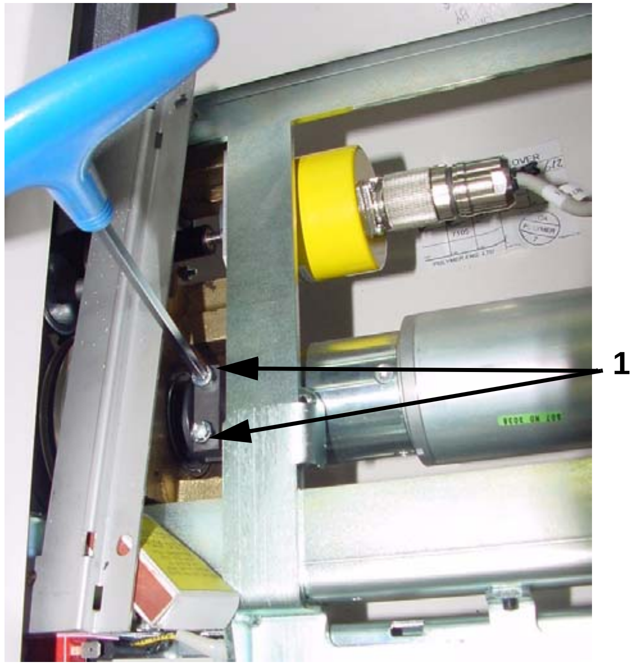


Figure 5-52:

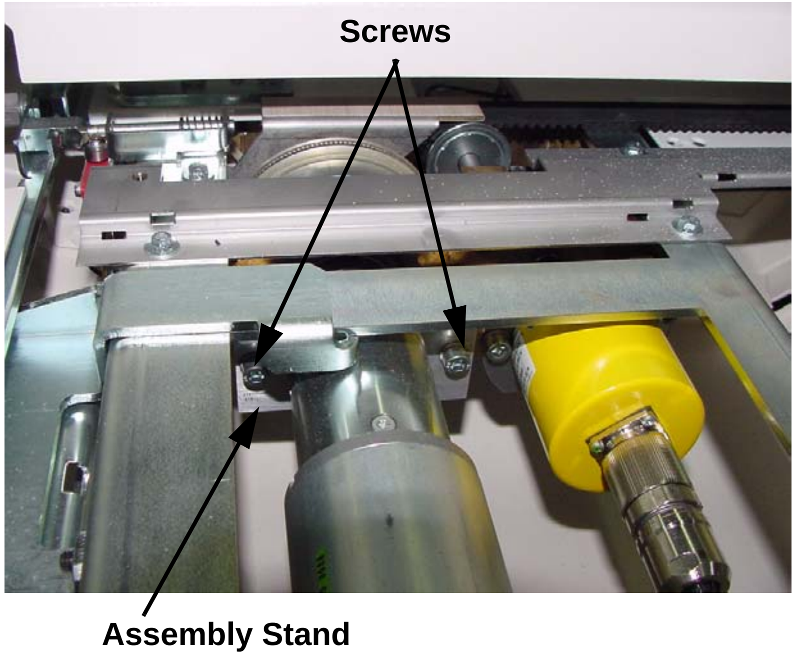


Figure 5-53:

Installing the Horizontal Tabletop Motor

Install the new Horizontal Tabletop Motor, proceeding in the reverse order of the previous removal procedure (Removing the Horizontal Tabletop Motor)

> **NOTE:**
>
> Tighten both screws from the axle (1 in *Figure 5-52*) using 10.2 Nm (+5%) torque and secure it with LOCTITE 242.

Tests and Adjustments

1. Check the horizontal movement of the Patient Table.
2. Test the table function using the appropriate keys on the Gantry operating panels.

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

Tabletop Encoder

Read these instructions completely prior to beginning the replacement of the encoder.

Follow all procedures for removing and installing the Tabletop Encoder.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in these instructions.

Tighten the screws and nuts using the torque specifically indicated in these instructions. Secure them with Loctite if required.

Secure cables with cable ties and/or cable clamps and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

Service tool set

Preliminary Steps

1. Remove the table covers according to the instructions, *"Removing Table Covers" on page 5-30*.
2. Power OFF the system by turning Switch F1 in the PDC OFF.
3. Remove the three screws from the cover (see *Figure 5-54*).
4. Additionally, there are five screws to remove to avoid damage during the lifting of this cover (at a later stage).

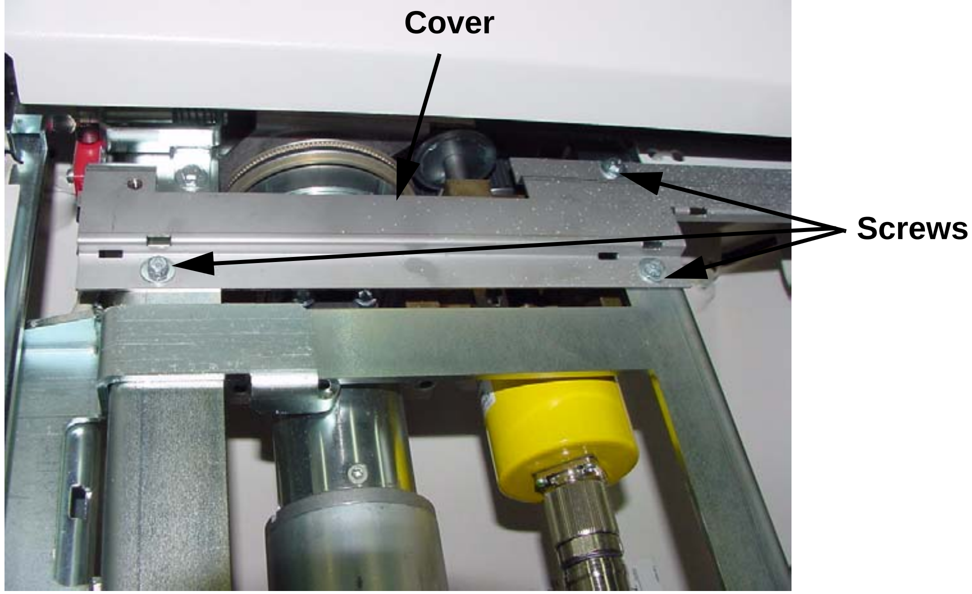


Figure 5-54: Horizontal Tabletop Motor Cover

Removing the Tabletop Encoder

1. Lift this part of the covers lightly to allow the screw to be removed from the axle clutch (1 in *Figure 5-55*).
2. Disconnect the connector B71 1 Xl (see *Figure 5-55*).
3. Remove three screws (see *Figure 5-55*).
4. Remove the defective encoder.
5. Remove three screws from the assembly stand of the old encoder.

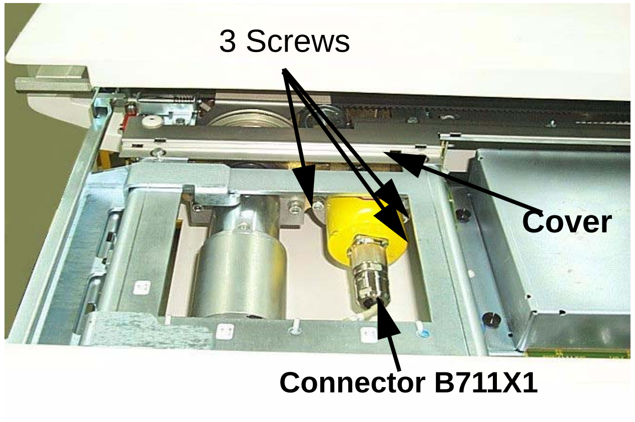


Figure 5-55:

Installing the Tabletop Encoder

Install the new encoder, proceeding in the reverse order of the previous procedure (Removing the Tabletop Encoder).

Tests and Adjustments

1. Check the horizontal movement of the Patient Table.
2. Test the Patient Table functions using the appropriate keys in the Gantry operating panels.

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

Horizontal Motor for Tabletop Support

Read these instructions completely prior to beginning the replacement of the motor.

Follow all procedures for removing and installing the Horizontal Motor Top Support.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables themselves for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in this chapter.

Tighten the screws and nuts using the torque specifically indicated in these instructions and secure them with Loctite if required.

Secure cables with cable ties and/or cable clamps as indicated and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

- Service tool set
- Loctite 242

Preliminary Steps

1. Remove the table covers according to the instructions, *“Removing Table Covers” on page 5-30*.
2. Power OFF the system by turning Switch F1 in the PDC OFF.

Removing the Horizontal Motor for the Tabletop Support

1. Loosen both screws (1 in *Figure 5-56*).
2. Disconnect connector U71 0 Xl and remove all cable ties.
3. Remove both screws used to attach the motor (2 in *Figure 5-56*).
4. Remove four screws from the assembly stand of the old motor (see *Figure 5-57*).

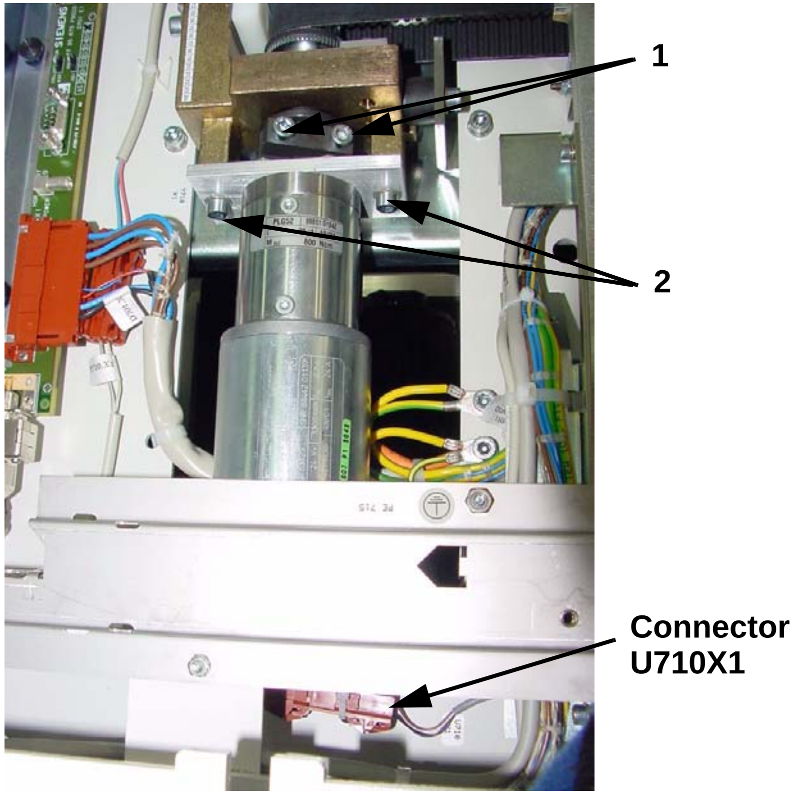


Figure 5-56: Horizontal Motor for Tabletop Support

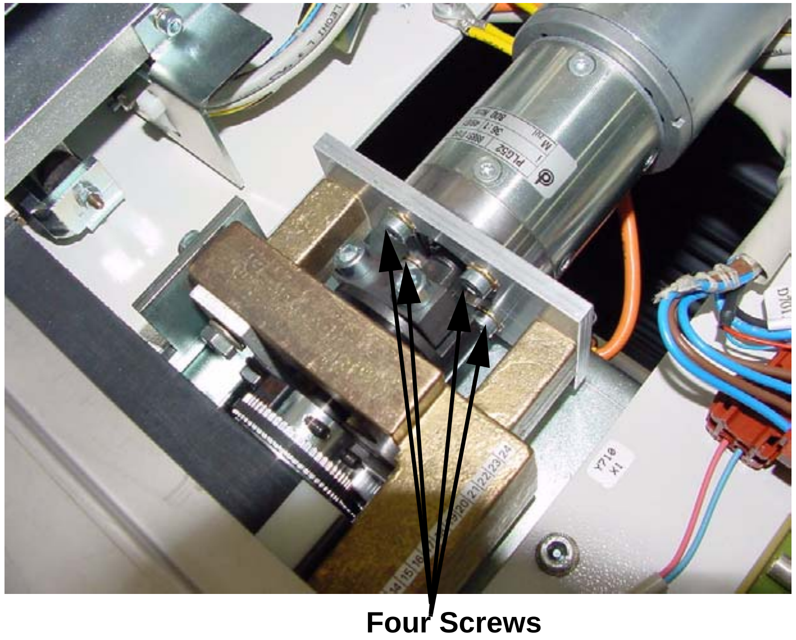


Figure 5-57: Assembly Stand

Installing the Horizontal Motor for the Tabletop Support

Install the new Horizontal Motor for the Tabletop Support, proceeding in the reverse order of the previous procedure (Removing the Horizontal Motor for the Tabletop Support).

> NOTE:
>
> Tighten both screws from the axle (I in *Figure 5-57*) using 10.2 Nm (5%) torque and secure it with LOCTITE 242.

Tests and Adjustments

1. Test the horizontal movement of the Patient Table (Tabletop/Tabletop Support).
2. Test the table functions using the appropriate keys in the Gantry operating panels.
3. Measure the gap (*Figure 5-58*) between the brake disk and the anchor (Y710) and adjust if necessary. The gap must be 0.15± 0.05 mm wide.

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

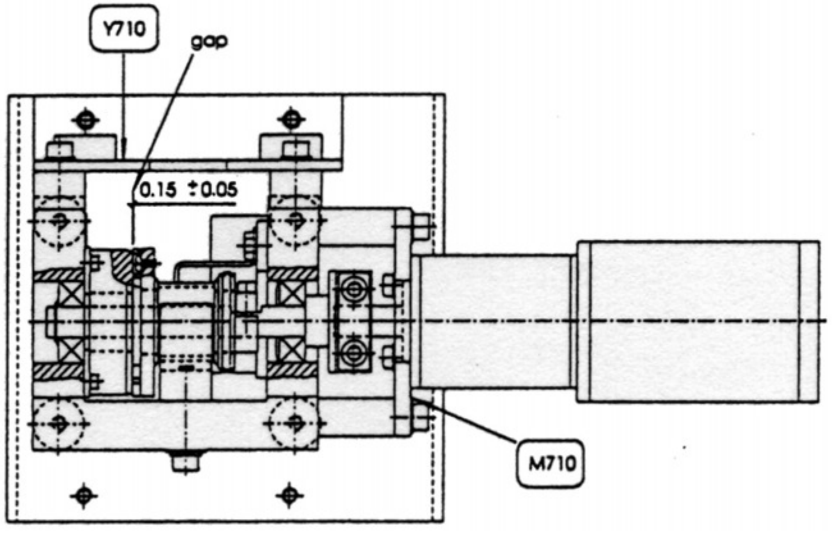


Figure 5-58: Y710 Top Support Brake-M71O Tabletop Support Motor

PT Horizontal Board

Read these instructions completely prior to beginning the replacement of the board.

Follow all procedures for removing and installing the PT Horizontal Board.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in the instructions in this chapter.

Tighten the screws and nuts using the torque indicated in these instructions. Secure them with Loctite if required.

Secure cables with cable ties and/or cable clamps as indicated and ensure that they match their original status.

Required Tools and Auxiliary Materials

Service tool set

Preliminary Steps

1. Remove the table covers according to the instructions, *“Removing Table Covers” on page 5-30*.
2. Power OFF the system by turning Switch F1 in the PDC OFF.

Removing the PT Horizontal Board

1. Remove the four screws from the board cover (1 in *Figure 5-59*).
2. Disconnect the seven XI-X8 connectors (*Figure 5-60*).
3. Remove the eight screws (2 in *Figure 5-60*).
4. Remove the defective board.
5. Remove the MCB/D333.

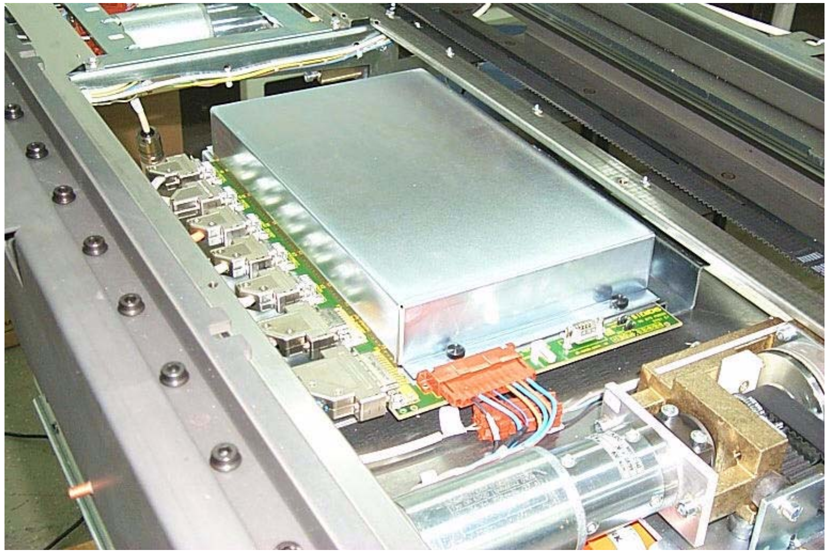


Figure 5-59:

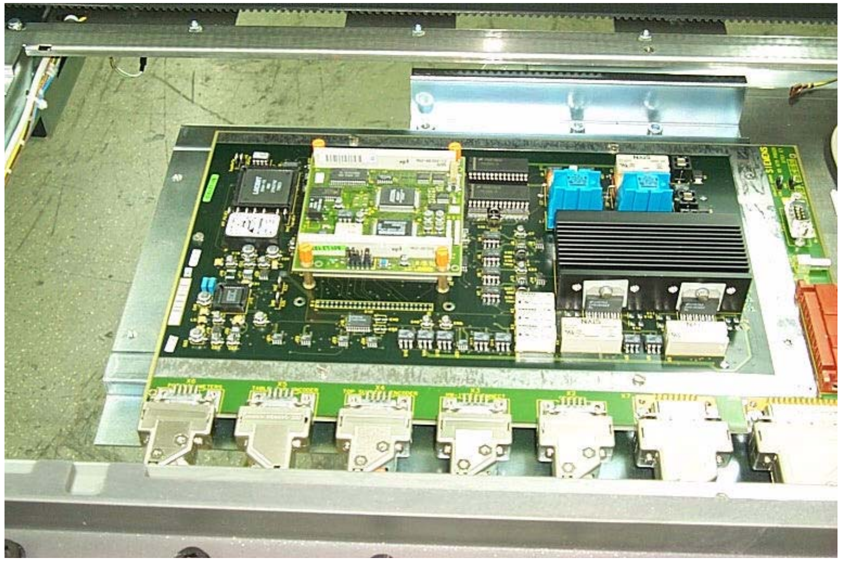


Figure 5-60:

Installing the PT Horizontal Board

Install the new board, proceeding in the reverse order of the previous procedure (Removing the PT Horizontal Board).

Tests and Adjustments

1. Check the horizontal movement of the Patient Table.
2. Perform the PTH adjustment (described in Section *"Patient Table Horizontal (PTH) Adjustment"*).
3. Test the table functions using the appropriate keys in the Gantry operating panels.

Final Steps

Final Steps

1. Install the covers, proceeding in the reverse order of the removal procedure (Section *"Removing Table Covers"*).
2. Connect the protective conductors as needed (ground).

Tabletop Drive

Read these instructions completely prior to beginning the replacement of the drive.

Follow all procedures for removing and installing the PT Horizontal Board.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in the instructions in this chapter.

Tighten the screws, bolts and nuts using the torque specifically indicated in these instructions. Secure them with Loctite when required.

Secure cables with cable ties and/or cable clamps as indicated and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

- Service tool set
- Flashlight
- Cable ties (various sizes)
- Voltmeter
- Spring scale 400N-Item Number: 44 14 884 RHO90
- Wire cable (approximately 1.5 meters x 3 mm minimum with hooks on the ends [used to tension the belt]).
- Magnetic screwdriver or equivalent (~30 cm in length)
- Hex key on Allen wrench-1 mm
- 4-5 mm drift punch (*Figure 5-68*)
- Loctite 242

Removing the Tabletop Drive

NOTE:

Read each step thoroughly and proceed exactly as directed in these instructions.

Before beginning the procedure, move the Patient Table to vertical work position 125 at the Gantry panels. Use the corresponding keys on the Gantry operating panel or the service key on the table. Move the Table (Tabletop + Top Support) to the back end horizontal position.

1. Remove the table covers as described in Section *"Removing Table Covers"*.
2. Power OFF the system by turning Switch F1 in the PDC OFF.
3. Push the Tabletop all the way forward.
4. Remove the rear covers (*Figure 5-61*).

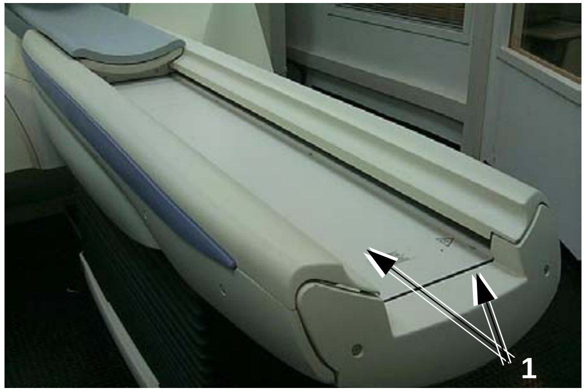


Figure 5-61: Rear Covers

1. Remove the table covers as described in Section *"Removing Table Covers"*.
2. Power OFF the system by turning Switch F1 in the PDC OFF.
3. Push the Tabletop all the way forward.
4. Remove the rear covers (1, 2 in *Figure 5-62*).

5. Remove the screws (1 in *Figure 5-62*), then remove the small belt (2 in *Figure 5-62*) of the R711 potentiometer (3 in *Figure 5-62*).

NOTE:

The wires from the old potentiometer will be de-soldered after installing the new drive and immediately soldered to the new potentiometer.

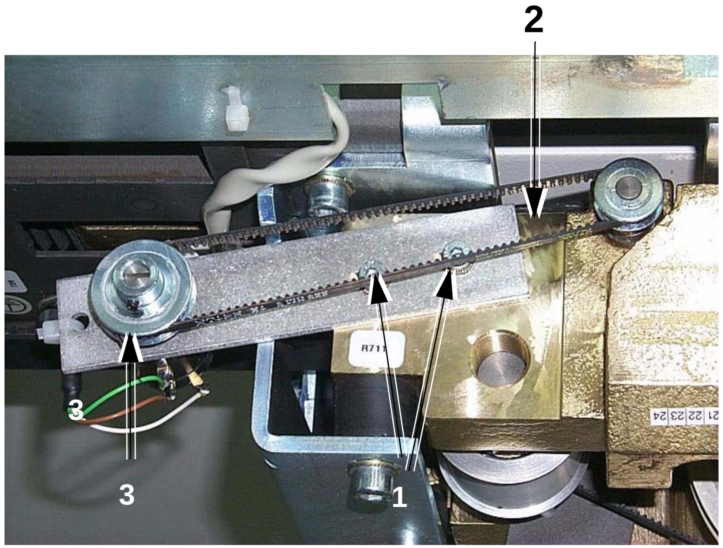


Figure 5-62: Screws, Small Belt and Potentiometer

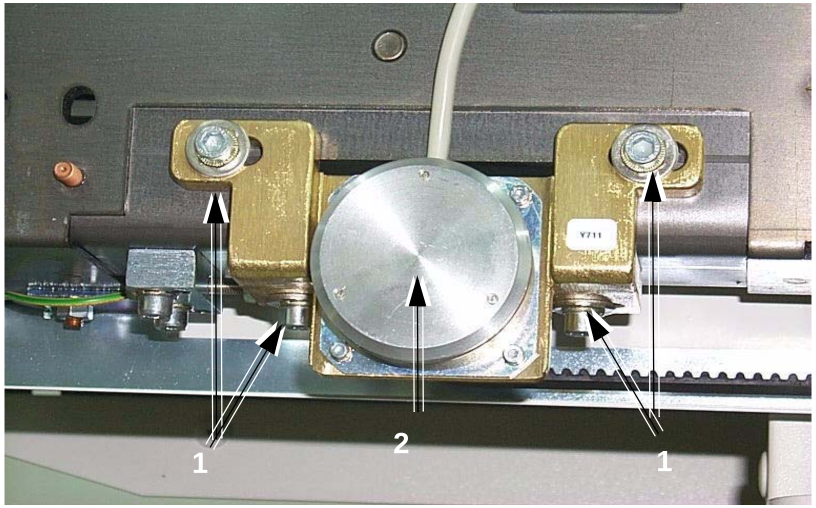


Figure 5-63: Guide Roller

6. Loosen (two full turns) the four screws (1 in *Figure 5-63*, 1 in *Figure 5-66*) of the guide roller (2 in *Figure 5-63*).
7. Loosen the backing nut (2 in *Figure 5-65*, 3 in *Figure 5-66*) and loosen the belt by turning the tensioning screw (1 in *Figure 5-65*, 2 in *Figure 5-66*) to the left

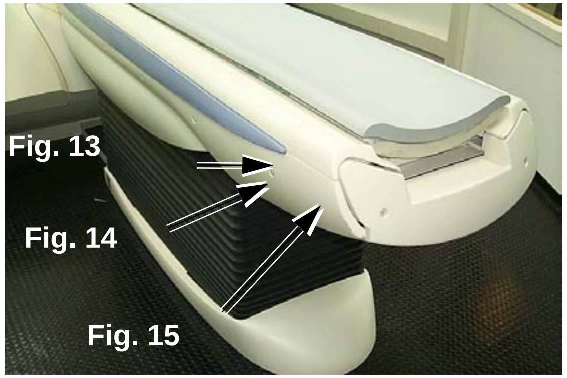


Figure 5-64: Patient Table-rear side view

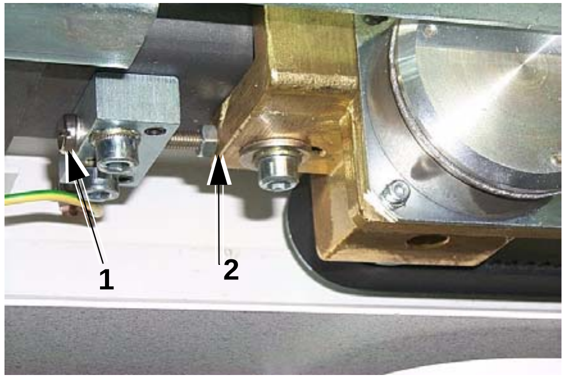


Figure 5-65: Tensioning Screw and Backing Nut

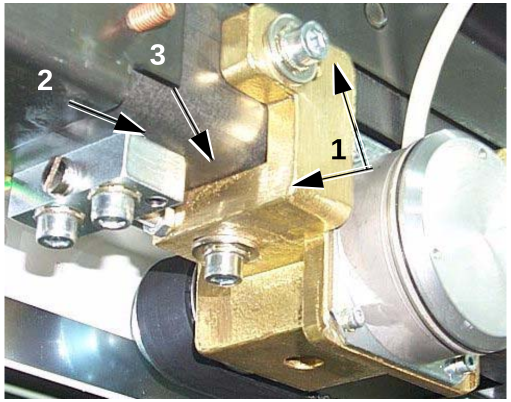


Figure 5-66: Guide Roller Screws, Tensioning Screw and Backing Nut

8. Push the tabletop all the way back (approximately 320 mm in front of the last end stop). Remove both screws from the belt coupling (1 in *Figure 5-67*).
9. Use a 4 mm drift punch (*Figure 5-68*) to hit the drift pin (2 in *Figure 5-67*) upward, out of the belt coupling.
10. Remove the screw (3 in *Figure 5-67*) from the belt coupling and remove the belt coupling.

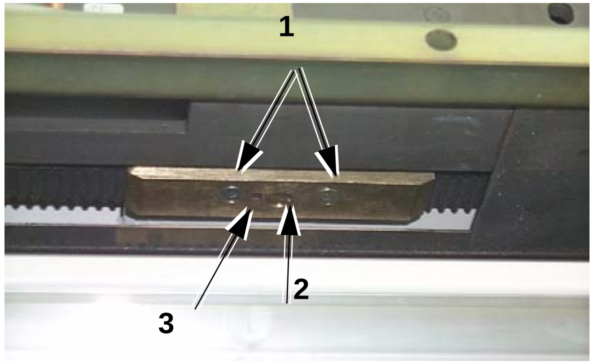


Figure 5-67: Belt Coupling

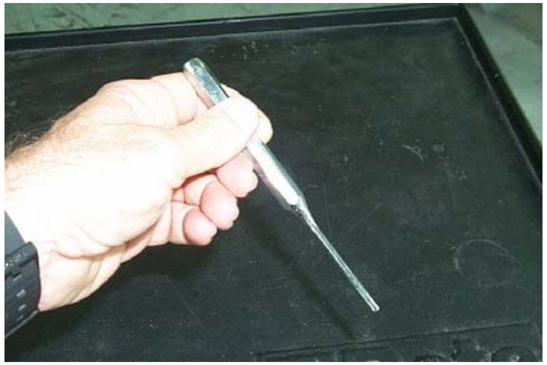


Figure 5-68: 4 mm Drift Punch

11. Remove the belt from the Guide Roller/Toothed Gear (*Figure 5-70*) of the Tabletop Drive unit.

NOTE:

When removing the belt, draw a diagram indicating the path of the belt through the individual gear wheels (*Figure 5-70*).

Re-thread the belt the same manner when reinstalling it.

12. Disconnect the connectors M711/U711 XI/B711 XI/E712 XI (Horizontal Tabletop Motor/Encoder) and remove all cable ties from the Drive Unit Holder (3 in *Figure 5-73*).
13. Remove the eight screws (1 in *Figure 5-72*, 1 in *Figure 5-73*, 1 in *Figure 5-74*) from both sides of the cover (2 in *Figure 5-73*, 2 in *Figure 5-74*).

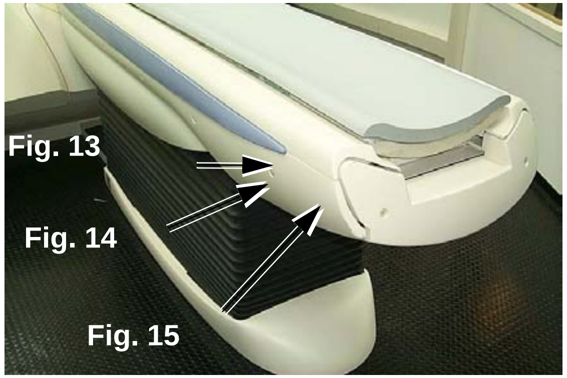


Figure 5-69: Patient Table-rear side view

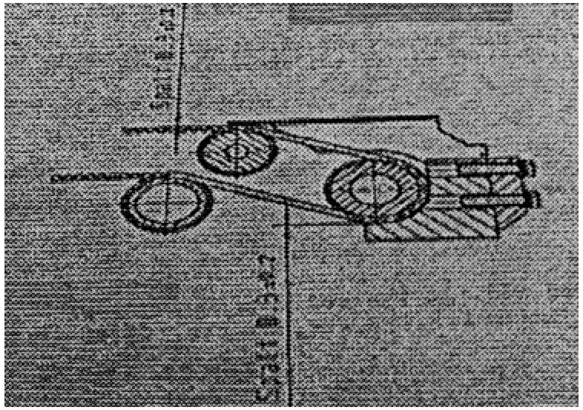


Figure 5-70: Belt, Guide Roller and Toothed Gear

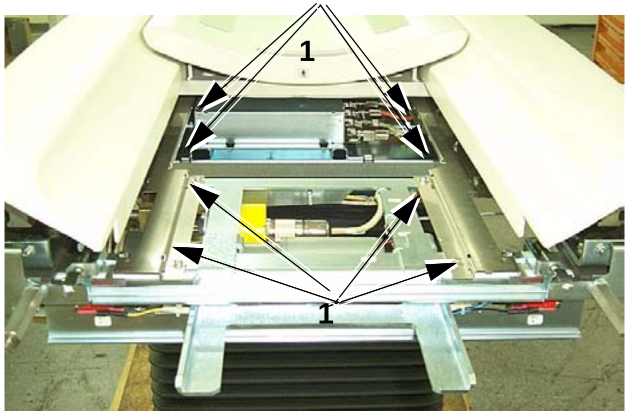


Figure 5-71: Upper Forward Cover-eight bolts

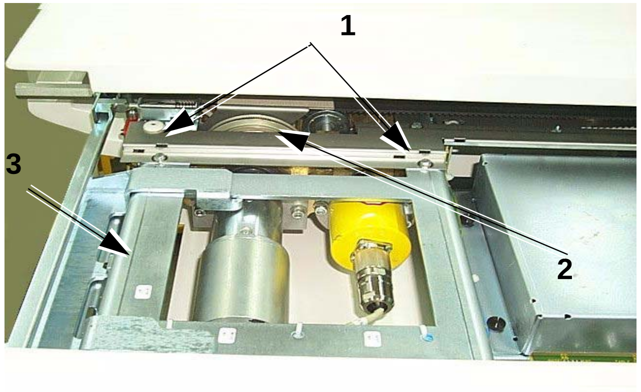


Figure 5-72: Drive Unit Holder and Cover

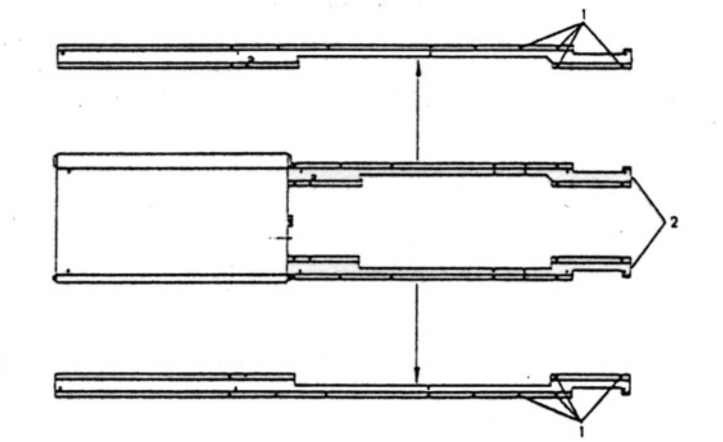


Figure 5-73: Disassembled Upper Forward Cover-Three Views

14. Tap the drift pin (2 in *Figure 5-78*) with a 4 mm drift punch and a small hammer (*Figure 5-68*) to remove it.

15. Remove the six bolts (1 in *Figure 5-77*, *Figure 5-78*, *Figure 5-79* and *Figure 5-80*, bolts 1 in *Figure 5-76*) and the two bolts from the switch bar (1 in *Figure 5-74*, bolts 3 in *Figure 5-76*).

NOTE:

Remove both the drive and the holder (2 in *Figure 5-74*).

⚠ **CAUTION**

THE DRIVE IS RELATIVELY HEAVY. SUPPORT THE DRIVE SECURELY WHILE LOOSENING THE SCREWS.

USE CAUTION WHEN LIFTING THE DRIVE OUT TOWARD THE BOTTOM, TO AVOID PULLING OUT THE WIRES.

16. Remove the drive unit.

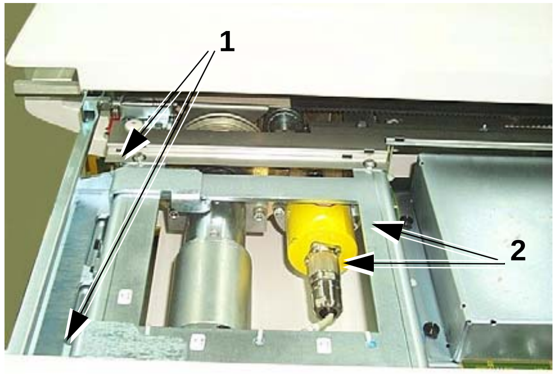


Figure 5-74: Switch Bar, Drive and Holder

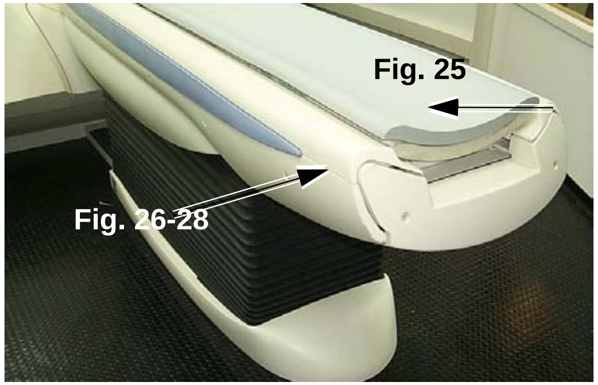


Figure 5-75: Patient Table-rear side view

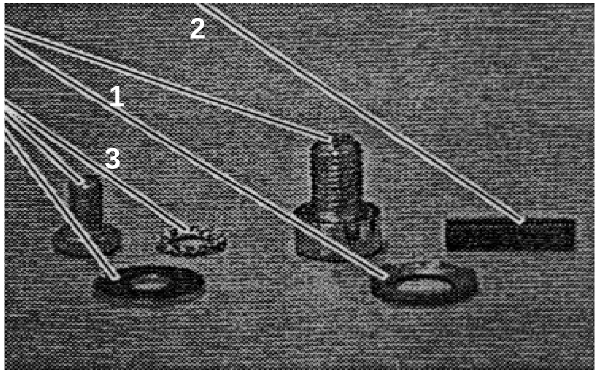


Figure 5-76: Allen Bolts and Drift Pin

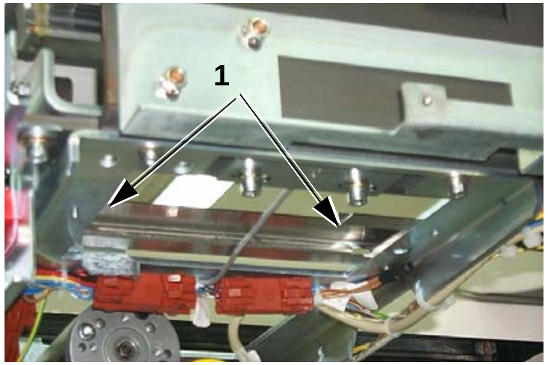


Figure 5-77: Screw Locations

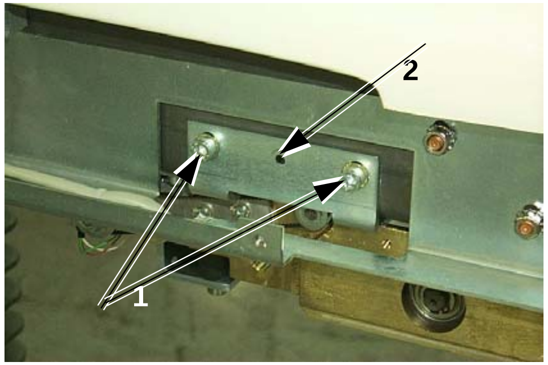


Figure 5-78: Screw Locations and Drift Pin

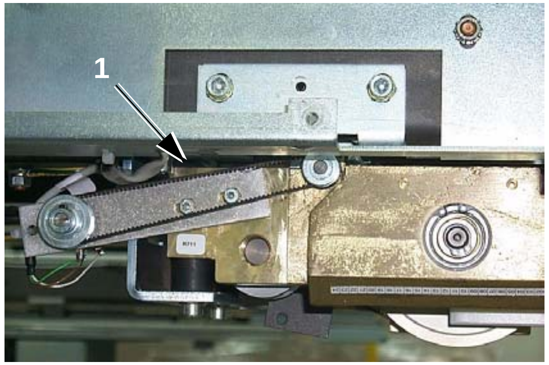


Figure 5-79: Screw Location

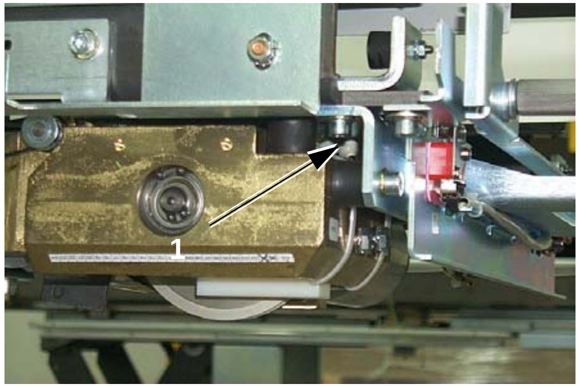


Figure 5-80: Screw Location

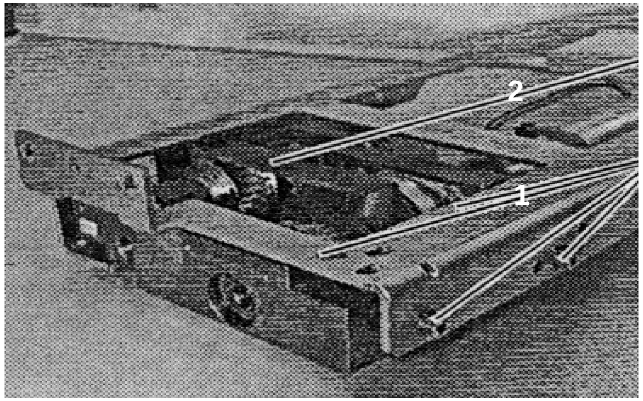


Figure 5-81: Disassembled Tabletop Drive-support screws location

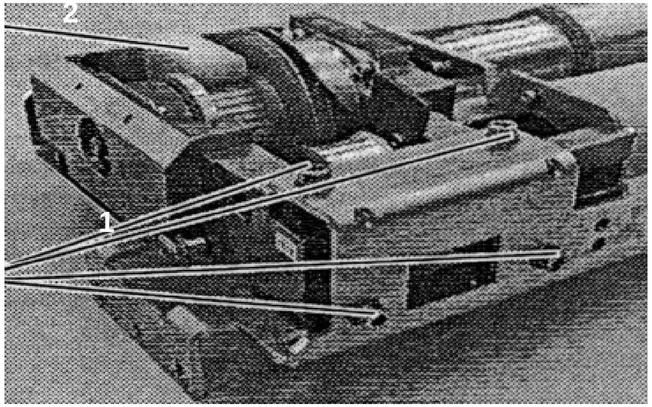


Figure 5-82: Disassembled Tabletop Drive-cover

17. Place the drive as shown in *Figure 5-81*.
18. Remove the screws (1 in *Figure 5-81* and *Figure 5-82*) from the Tabletop Drive Support and install the support on the new drive.

19. Before installing the drive, check the distance of both covers (Toothed Belt Skip Bar) (2 in *Figure 5-81*, *Figure 5-82* and *Figure 5-84*).
20. The distance between the covers and the gear wheels must be 2.2 mm ± 0.1 mm.
21. If this value is out of tolerance, adjust the cover that appears in 2 in *Figure 5-81* and 1 in *Figure 5-83* with the screws in 2 in *Figure 5-82*. Then adjust the cover in 2 in *Figure 5-82* and 3 in *Figure 5-83* with the screws in 4 in *Figure 5-83*.

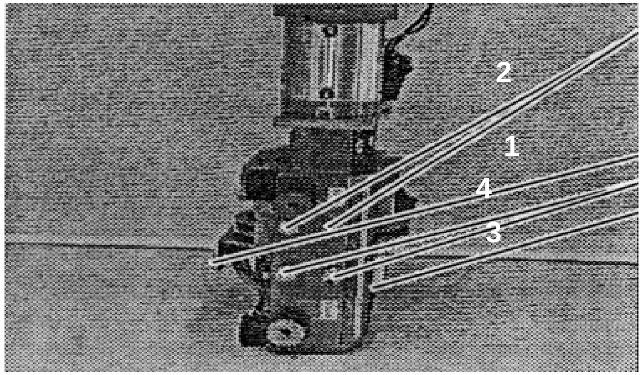


Figure 5-83: Disassembled Tabletop Drive-standing on side

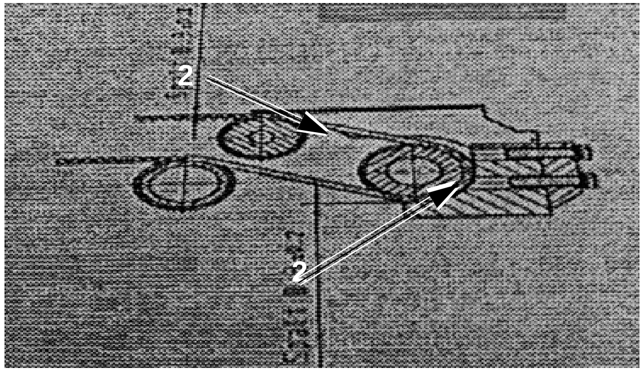


Figure 5-84: Gear Wheels-cut-away diagram

Installing the Tabletop Drive

Read the following note carefully before installing the drive.

NOTE:

Install R711 Potentiometer and belt only after the drive unit and the large belt have been installed and the belt tension has been adjusted.

1. Install the drive with the bolts as shown in 1 in *Figure 5-88*,-*Figure 5-91* (bolts appear in 1 in *Figure 5-86*) and in l in *Figure 5-79* of the switch bar (bolts appear in 3 in *Figure 5-86*).
2. Tap in the drift pin (2 in *Figure 5-89*, 2 in *Figure 5-86*) using a 4 mm drift punch (*Figure 5-68*).

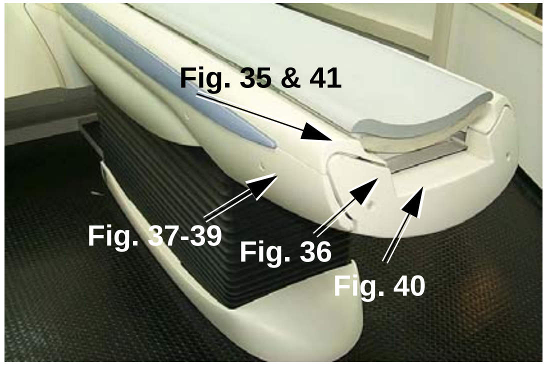


Figure 5-85: Patient Table-rear side view

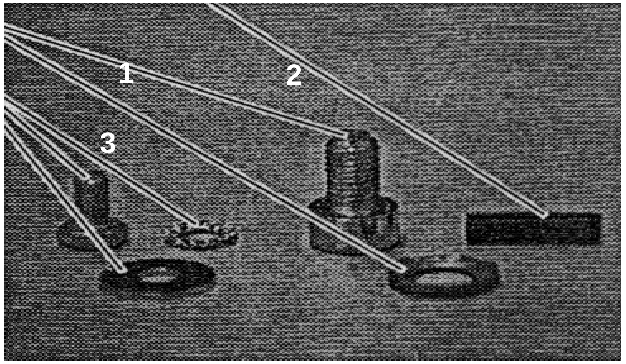


Figure 5-86: Bolts. Washers and Drift Pin

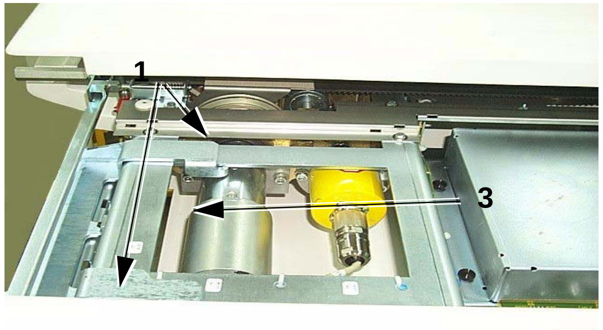


Figure 5-87: Tabletop Drive-screw locations

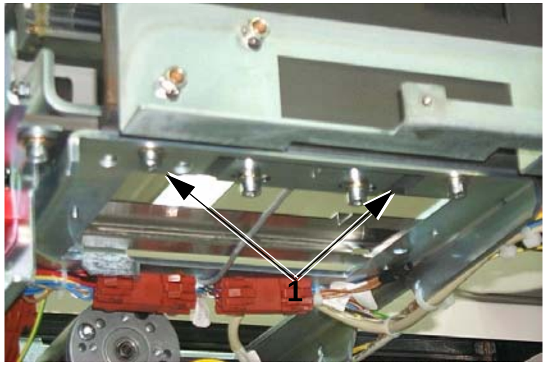


Figure 5-88: Tabletop Drive-screw locations

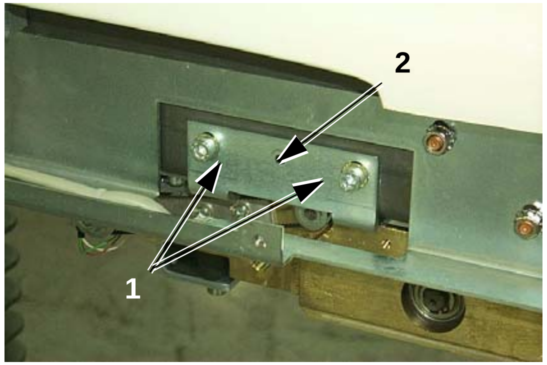


Figure 5-89: Tabletop Drive-screw locations

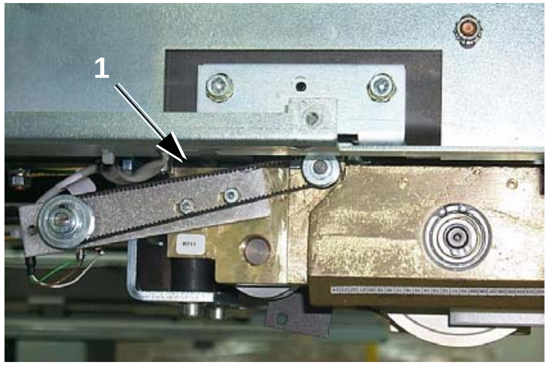


Figure 5-90: Tabletop Drive-screw locations

3. Install the eight screws (1 in *Figure 5-92*, *Figure 5-93* 1 in *Figure 5-94*) on both sides of the cover (2 in *Figure 5-93*, 2 in *Figure 5-94*).

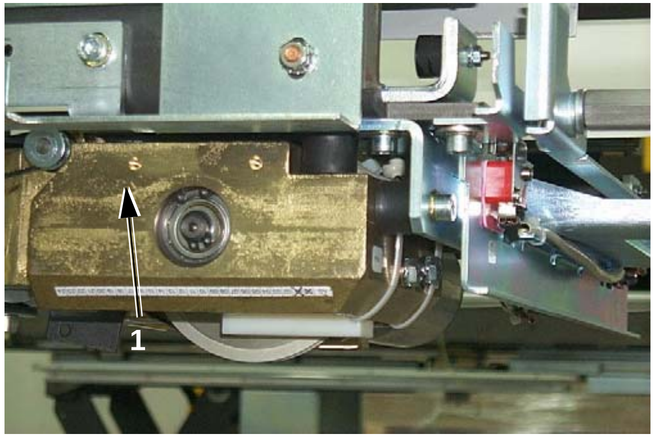


Figure 5-91: Tabletop Drive-screw locations

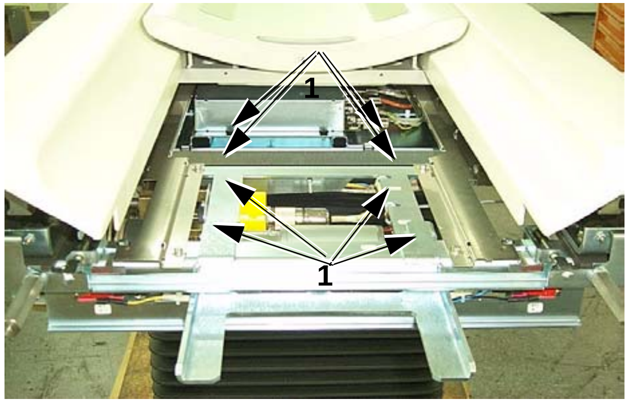


Figure 5-92: Cover Screws

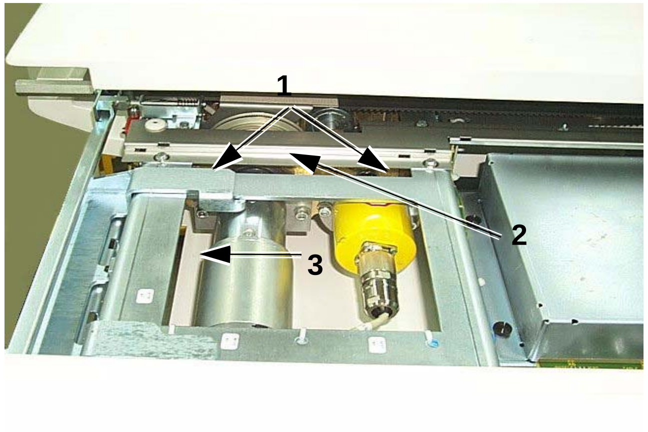


Figure 5-93: Cover and Screws

4. Connect the connectors M711 / U711 XI / B711 XI / E712 XI (Horizontal Tabletop Motor/ Encoder) and secure all cable ties at the Drive Unit Holder (3 in *Figure 5-93*) as tied previously.

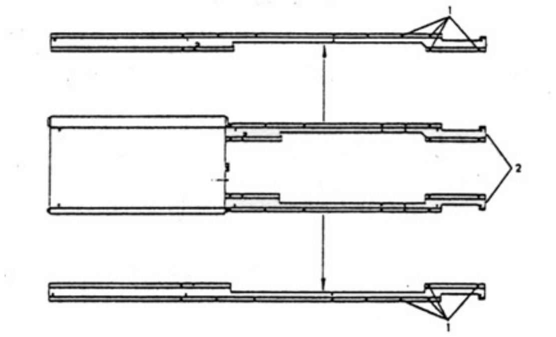


Figure 5-94: Disassembled Upper Forward Cover-Three Views

5. Thread the belt over the gear wheels of the Table Top Drive.

> **NOTE:**
>
> Proceed according to *Figure 5-97*.

6. Pull the belt ends to where the clamp was removed and install the clamp with the screw on the belt ends (3 in *Figure 5-96*).

> **NOTE:**
>
> The clamp holes and the plastic parts must align with the corresponding holes in the table coupling.
>
> When installing the belt coupling, use a new screw (Item-No.: 34 25 196, included in delivery).

7. Push the tabletop to a position that allows access to the belt clamp (Top Support all the way back/Tabletop approximately 320 mm from the back end position).
8. Use a 4 mm drift punch to tap the drift pin upward, into of the belt coupling (2 in *Figure 5-96*).
9. Apply Loctite242 to the screws (according to the manufacturer's instructions) and tighten them (1 in *Figure 5-96*).

NOTE:

Tighten both screws after the drift pin is in the correct position.

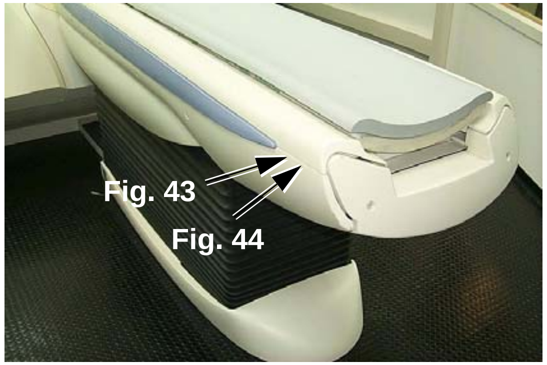


Figure 5-95: Patient Table-rear side view

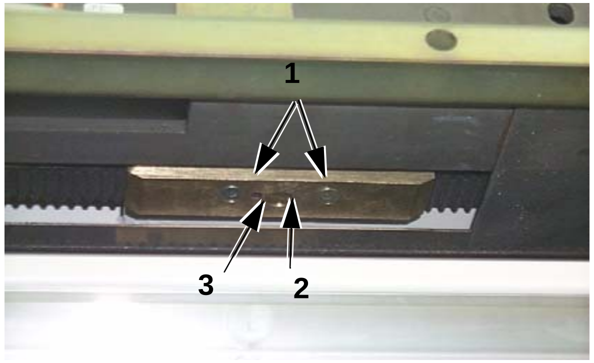


Figure 5-96: Belt Clamp Screw Positions

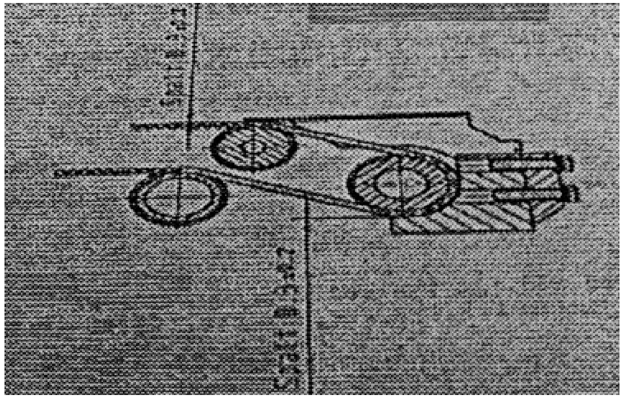


Figure 5-97: Tabletop Gear Wheels

10. Adjust the belt tension (belt tension 400 N + 20 N).
11. To adjust the belt tension, attach the spring scale (2 in *Figure 5-100*) to the steel cable (1 in *Figure 5-99*, 1 in *Figure 5-100* in 2 in *Figure 5-99*, 2 in *Figure 5-101*).

NOTE:

Insert the M10 x 30 screw in the hole (2 in *Figure 5-101*) of the Guide Roller (1 in *Figure 5-101*) and attach the cable hook to it (2 in *Figure 5-99*). Before setting the spring scale, check (2 in *Figure 5-100*), whether the M10 x 30 screw is completely inserted (2 in *Figure 5-101*).

12. Set the spring scale to 400 N ± 20 N (*Figure 5-100*).

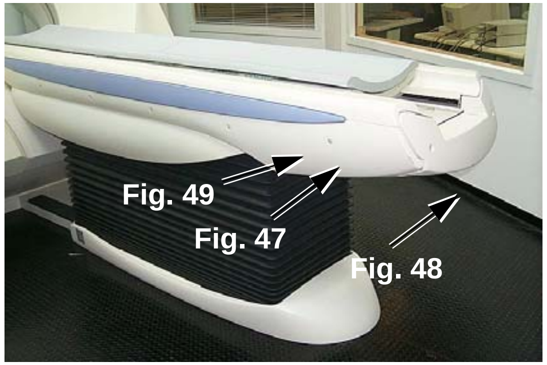


Figure 5-98: Patient Table-rear side view

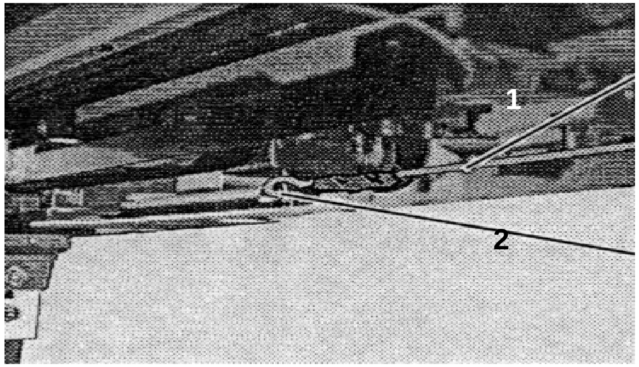


Figure 5-99: Steel Cable and Hook

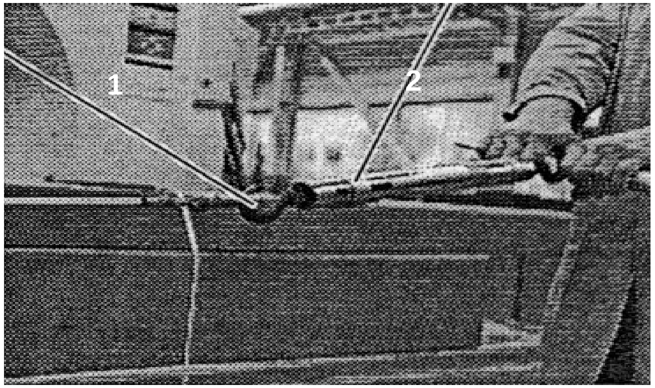


Figure 5-100: Steel Cable and Spring Scale

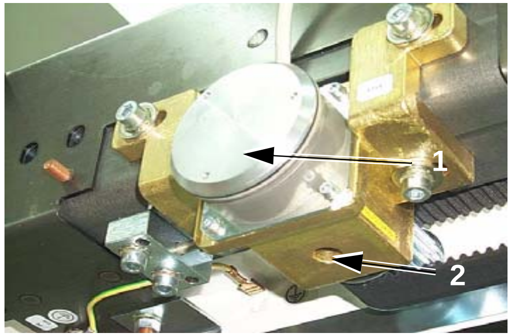


Figure 5-101: Guide Roller and M10 x 30 Screw

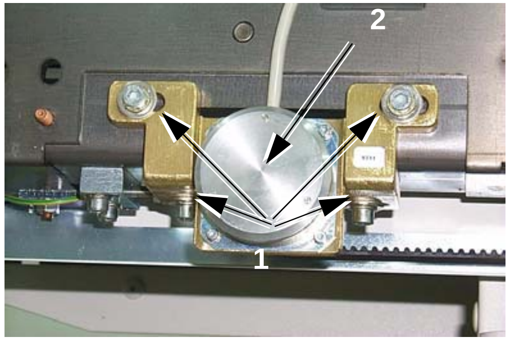


Figure 5-102: Guide Roller and Screws

13. Tighten the four screws (1 in *Figure 5-102* and 1 in *Figure 5-103*) of the guide rollers (2 in *Figure 5-102*).
14. Tighten the set screw (2 in *Figure 5-103* and 1 in *Figure 5-104*) to the end stop.
15. Tighten the backing nut (3 in *Figure 5-103*).

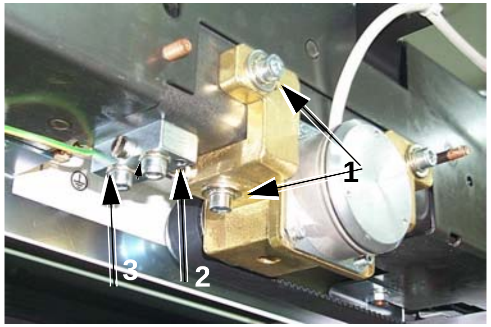


Figure 5-103: Guide Roller Screws and Set Screw

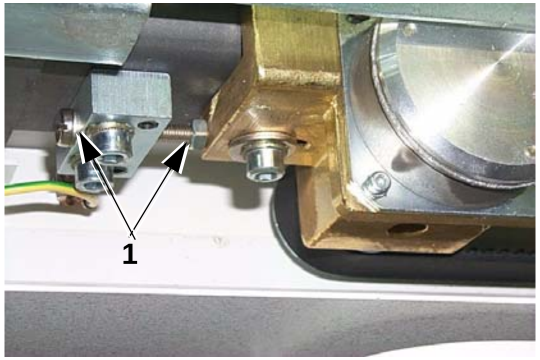


Figure 5-104: Set Screw

16. Solder the wires from the old potentiometer to the new potentiometer.

Adjustment of Potentiometer R711

To install and adjust the potentiometer, move the tabletop all the way back.

1. Place the toothed gear wheel (4 in *Figure 5-107*) on the potentiometer shaft (1 in *Figure 5-107*).
2. Tighten the gear wheel screw (3 in *Figure 5-107*) securely. Use Loctite242 (according to the manufacturer's instructions) when tightening the screw.
3. Turn the shaft of the potentiometer (1 in *Figure 5-107*) clockwise to the end stop.
4. From this position, turn the shaft back in the counterclockwise direction to 200^{o} (± 10^{o}).
5. Tighten the potentiometer and the holder (2 in *Figure 5-106*, 2 in *Figure 5-107*) with the screws (1 in *Figure 5-106*), as shown in *Figure 5-106*.
6. Reinstall the small potentiometer belt (3 in *Figure 5-106*) on the toothed gear (4 in *Figure 5-106*) of the R711 potentiometer.

NOTE:

Use caution when installing the potentiometer belt, so that the shaft adjustment (adjustment 200(± 10) is not inadvertently shifted.

7. Power ON the system (SYS ON).

NOTE:

After powering ON the system and prior to adjusting the PTH, measure the voltage in this table position (Tabletop all the way back) between pins 2 (white) and 3 (green) on the potentiometer. The value must measure 0.55 V ± 0.2 V.

If the value does not fall within the this range, you must recheck the shaft adjustment on the potentiometer (200(± 10) from the end stop.

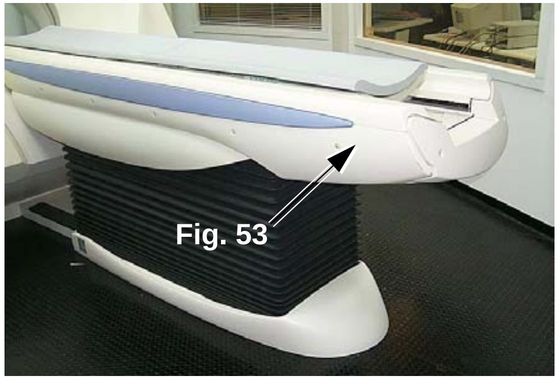


Figure 5-105: Patient Table-rear side view

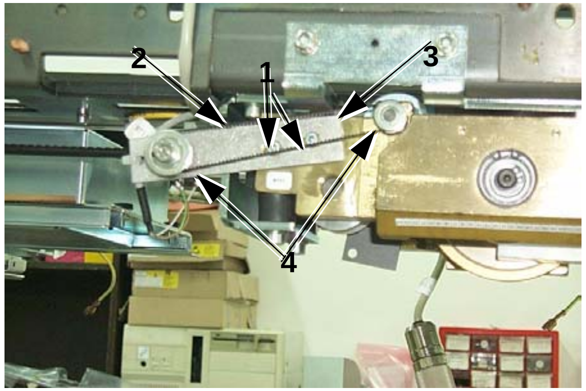


Figure 5-106: Potentiometer, Holder and Screws

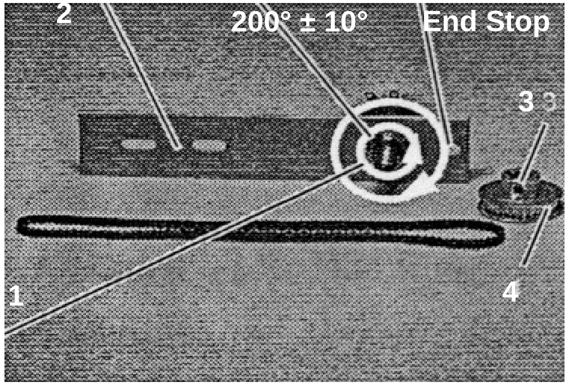


Figure 5-107:

Final Steps

1. Perform the PTH adjustment (described in section*“Patient Table Horizontal (PTH) Adjustment”*).
2. Perform a few scans to check the system performance.

Top Support Drive

Read these instructions completely prior to beginning the replacement of the drive.

Follow all procedures for removing and installing the PT Horizontal Board.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in the instructions in this chapter.

Tighten the screws and nuts using the torque indicated in these instructions. Secure them with Loctite when required.

Secure cables with cable ties and/or cable clamps as indicated and ensure that they match their original status.

Required Tools and Auxiliary Materials

- Service tool set
- Cable ties (various sizes)
- Voltmeter
- Spring scale 400N-Item No. 44 14 884 RHO90
- Wire cable (approximately 1.5 meters x (3 mm minimum) with hooks on the ends (used to tension the belt).
- Magnetic screwdriver or equivalent (~30 cm in length)
- Hex key (Allen wrench)-1 mm
- 5-6 mm drift punch (*Figure 5-123*)
- Loctite 242

Removing the Top Support Drive

NOTE:

Read each step thoroughly and proceed exactly as directed in these instructions.

Before starting with the procedure, move the Patient Table to the work position (125) at the Gantry panels using the corresponding keys on the Gantry operating panel or the service key on the table. Move the complete Patient Table (Tabletop + Top Support) to the back end position.

1. Remove the table covers as described in Section *"Removing Table Covers"*.
2. Power OFF the system by turning Switch F1 in the PDC OFF.
3. Push the Top Support forward.
4. Remove the Front Plates (*Figure 5-109*) from both sides.
5. Push the table (Top Support +Tabletop) all the way forward.
6. Remove the Rear Cover (*Figure 5-110*).
7. Remove the Rear Top Cover (*Figure 5-110*).

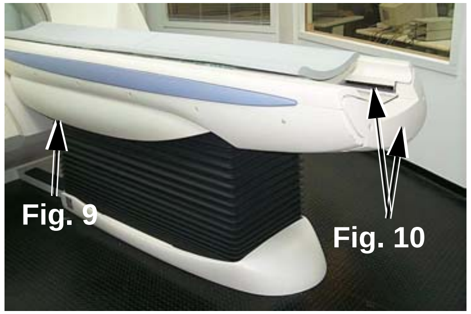


Figure 5-108: Patient Table-rear side view

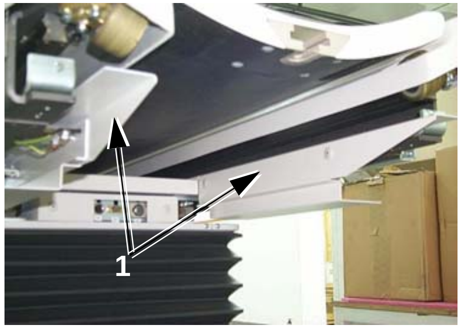


Figure 5-109: Front Plates

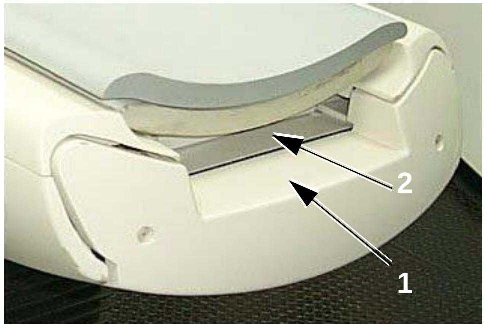


Figure 5-110: Rear Cover and Rear Top Cover

8. Remove the Upper Front Cover (*Figure 5-114*, *Figure 5-115*, *Figure 5-116* and *Figure 5-111*) -a connected part. To do so, loosen the protective conductor (5 in *Figure 5-111*, screw 4 *Figure 5-117*, *Figure 5-113*) and the screws along the entire length of the cover (*Figure 5-111*).
9. In addition, remove the cover of PCBA D701 (2 in *Figure 5-115*).

NOTE:

To remove the screws, (1 in *Figure 5-115*, 3, 4 in *Figure 5-111*, screw 2 in *Figure 5-117*, 3 in *Figure 5-117*) push the Tabletop all the way forward.

To remove both “Long cover screws” (2 in *Figure 5-114*, 2 in *Figure 5-116*, 2 in *Figure 5-111*, screw 1 in *Figure 5-117*), push the Tabletop all the way back.

Table 5-2: Types of Screws:

AMOUNT	NAME	TYPE	APPEAR IN FIGURES
11	M4 x 8	Hex-Head Screws	3 in *Figure 5-111* and *Figure 5-117*
10	M4 x 10	Allen Screws + 10 x M4 Nuts	4 in *Figure 5-111* and *Figure 5-117*
2	M4 x 18	Long Cover Screws	2 in *Figure 5-111* and *Figure 5-117*
1	M4 x 8	Allen Screws for Protective Conductor	5 in *Figure 5-111* and *Figure 5-117*

NOTE:

Ensure that the cover (1 in *Figure 5-111*) and the corresponding extensions (6 in *Figure 5-111*) are secured with the types and amounts of screws indicated at *Figure 5-117*.

Record which screws were used at which locations (refer to the drawing in *Figure 5-111*).

10. When all screws have been removed, remove the upper front cover from the front (*Figure 5-118*).

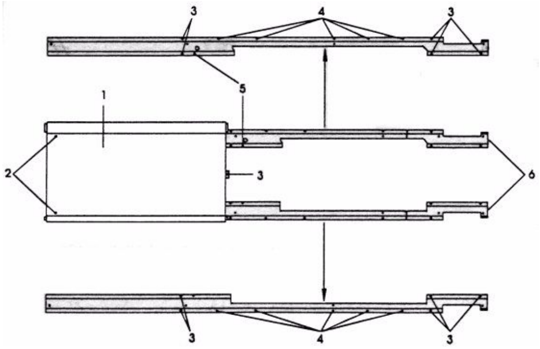

3
4
3
1
5
2
3
6
3
4
3

Figure 5-111: Upper Front Cover-three views

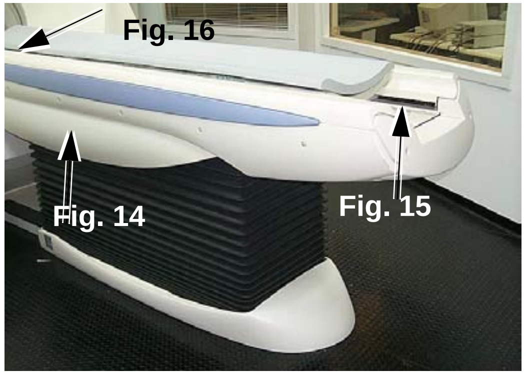


Fig. 16
Fig. 14
Fig. 15

Figure 5-112: Patient Table-rear side view

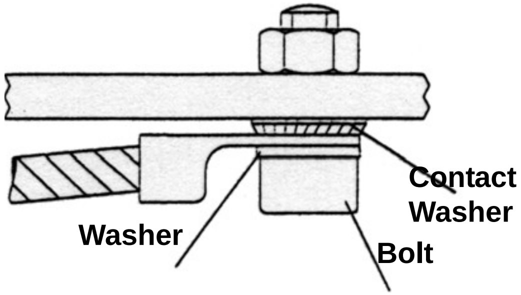

Contact Washer
Washer
Bolt

Figure 5-113: Protective Conductor Assembly

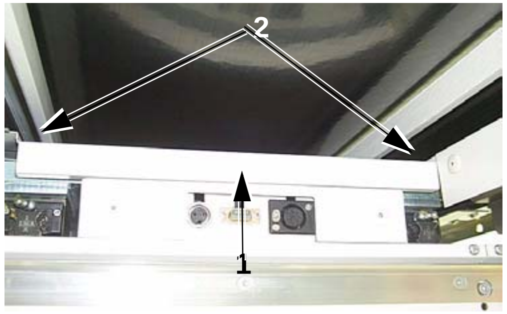


Figure 5-114: Upper Front Cover-underside front view

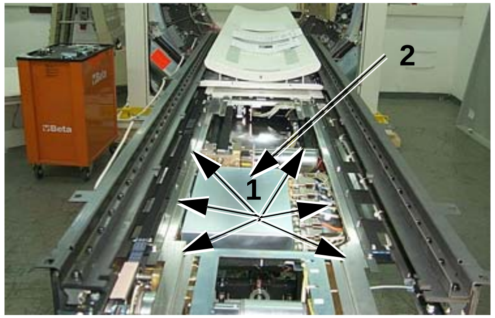


Figure 5-115: Upper Front Cover-upper rear view

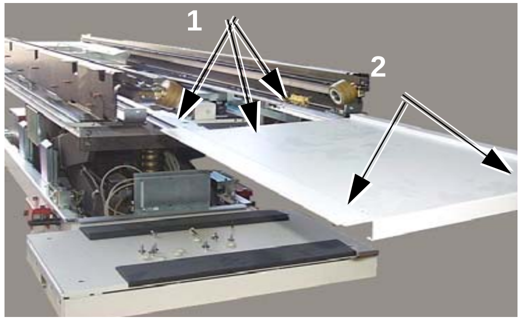


Figure 5-116: Upper Front Cover-front view

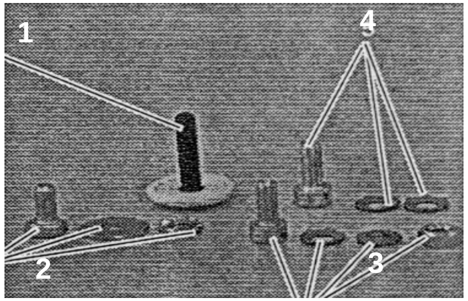


Figure 5-117: Types of Screws

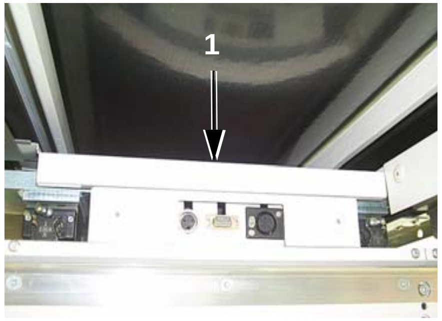


Figure 5-118: Upper Front Cover-underside front view

11. Remove the Upper Front Cover (1 in *Figure 5-118*). The Tabletop and Top Support are all the way back).
12. After removing the screws, lift the cover up and pull it out toward the front.
13. Move the table (Top Support + Tabletop) all the way forward.
14. Loosen the lock nut (1 in *Figure 5-120*).
15. Loosen both screws (2 in *Figure 5-120*).
16. Turn the set screw (3 in *Figure 5-120*) far enough back, until the large belt (4 in *Figure 5-120*) is very loose.
17. Tape the small belt (1 in *Figure 5-121*) from the toothed gear, to avoid interference with the potentiometer (1 in *Figure 5-122*) when pushing the large belt (2 in *Figure 5-121*).
18. Tap the drift pin (1 in *Figure 5-123* and 1 in *Figure 5-120*) out toward the bottom with a 5-6 mm drift punch and a hammer.

NOTE:

Do not tap out the drift pin that appears in 2 in *Figure 5-123*.

19. Remove both screws (3 in *Figure 5-123* and 2 in *Figure 5-120*).

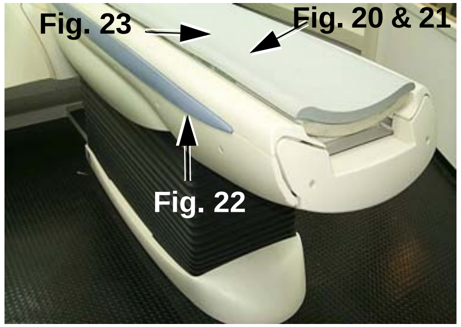


Figure 5-119: Patient Table-rear side view

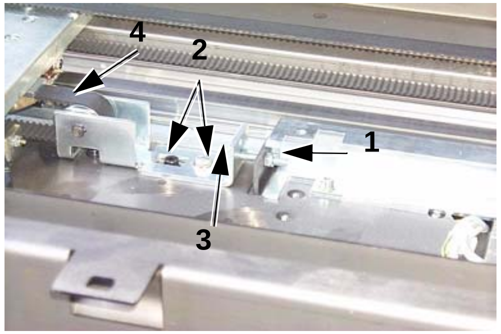


Figure 5-120: Screws and Lock Nut

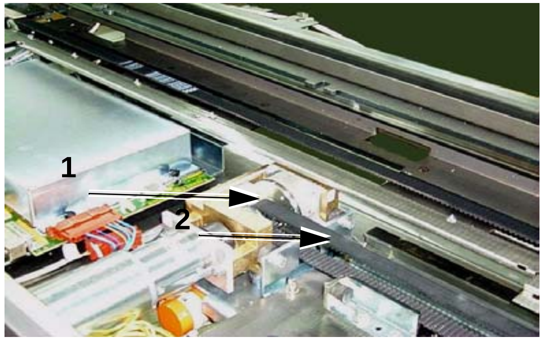


Figure 5-121: Small and Large Belts

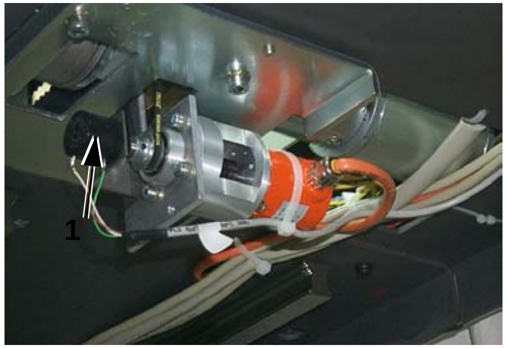


Figure 5-122: Potentiometer

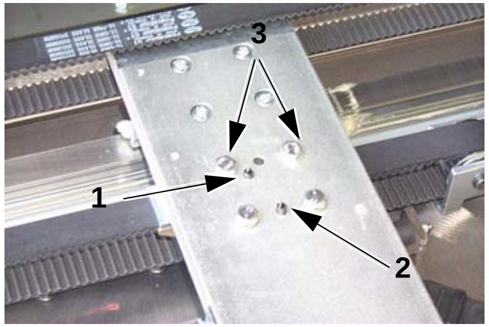


Figure 5-123: Drift Pins and Screws

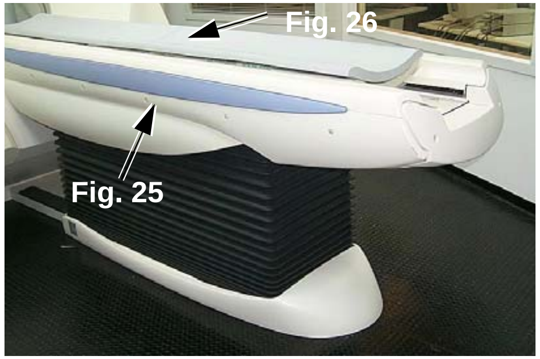


Figure 5-124: Patient Table-rear side view

20. Pull the belt by pushing the Top Support into a position in which, after rotating the belt clamp, (1 in *Figure 5-126*) the screw (2 in *Figure 5-126*) can be removed.
21. Remove the clamp (1 in *Figure 5-126*) and pull the belt out over the toothed gear of the drive (1 in *Figure 5-127*).

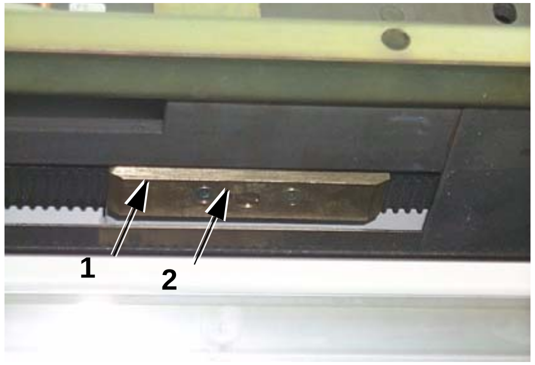


Figure 5-125: Belt Clamp and Clamp Screw

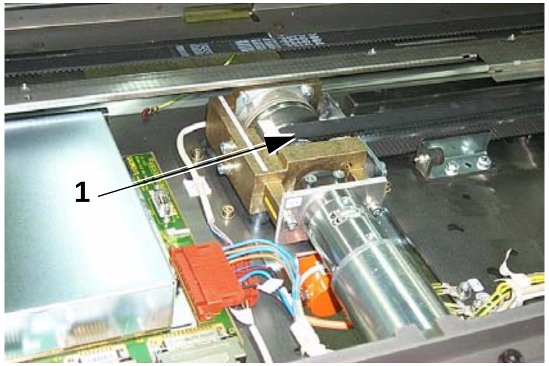


Figure 5-126: Large Belt Over Toothed Gear

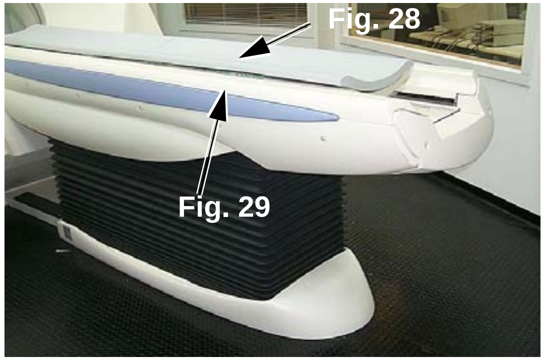


Figure 5-127: Patient Table-rear side view

22. Disconnect the plugs and remove the cable ties where necessary.
    - M 710.X1
    - Y 710.X1
    - D 701.X4

NOTE:

Prior to the next step, make a drawing of the wire connections.

23. De-solder the wires from the potentiometer (1 in *Figure 5-129*).
24. Remove the four bolts (1 in *Figure 5-128*, bolts 2 in *Figure 5-130*) and lift the drive out.

NOTE:

Two spacers (1 in *Figure 5-130*) are located under the bolts, from below (2 in *Figure 5-128*).

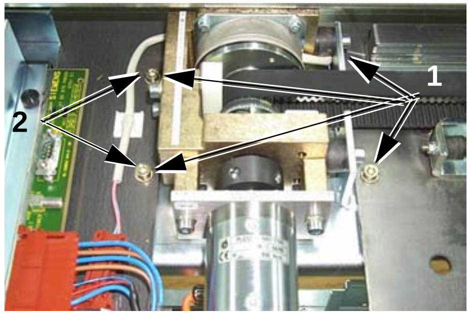


Figure 5-128: Four Screws on Drive

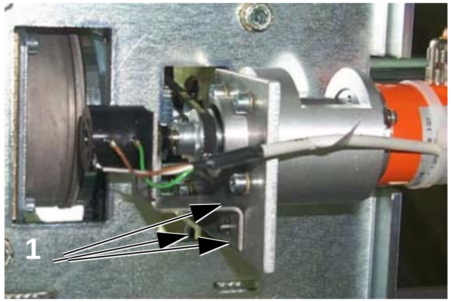


Figure 5-129: Potentiometer Wires-Solder Points

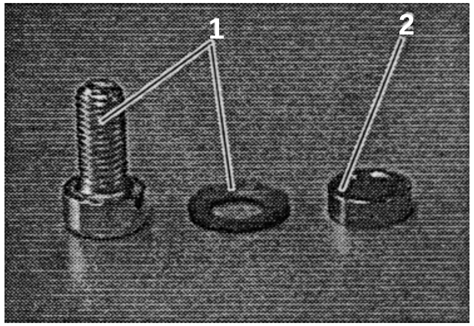


Figure 5-130: Bolt and Spacers

25. Remove the old drive.

Installing the Top Support Drive

Read the following notes carefully before installing the drive.

NOTE:

Install and adjust the potentiometer only after you have installed the drive and clamp and adjusted the tension on the large toothed gear.

1. Install the drive in the old position as shown in 1 in *Figure 5-132* and secure it with the four screws (1 in *Figure 5-133*).

NOTE:

There are two spacers 2 in *Figure 5-133* located under the screws, from below (2 in *Figure 5-132*).

2. Connect the following cables and secure them with cable ties as before.
    - M 710.X1
    - Y 710.X1
    - D 710.X4

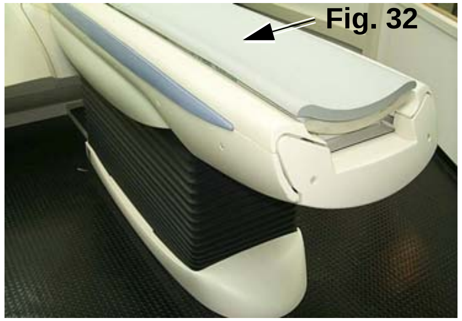


Figure 5-131: Patient Table-rear side view

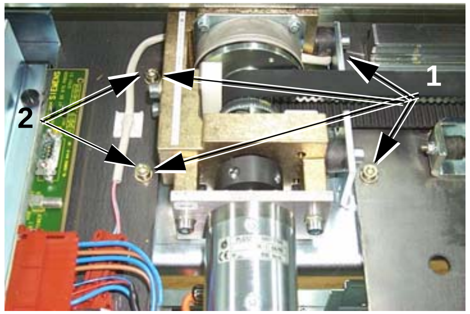


Figure 5-132: Drive in Position (with Belt In Place)

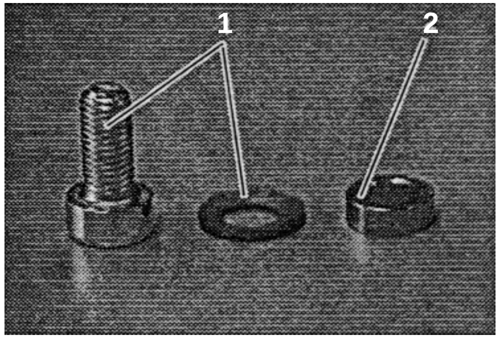


Figure 5-133: Bolt and Spacers

3. Move the table (Top Support + Tabletop) all the way forward.
4. Thread the belt back via the toothed gear of the drive (2 in *Figure 5-136*).
5. To thread the belt:
    a. Line up the belt at the underside of the toothed gear (3 in *Figure 5-136*).
    b. Turn the toothed gear by hand with the connecting piece of the motor (4 in *Figure 5-136*), until the belt lies against the underside of the skip bar (5 in *Figure 5-136*).
    c. Take a small screwdriver and run it underneath the belt and press it slightly upward.
    d. Continue to turn the axle, until the belt lies against the upper edge of the skip bar.
    e. Run the screwdriver underneath the belt again. The belt should now run around the toothed gear. Continue to pull the belt by hand.
6. Secure the clamp (1 in *Figure 5-135*) with the screw (2 in *Figure 5-135* and 2 in *Figure 5-138*) as before. Use Loctite 242 when installing the clamp.

NOTE:

When installing the clamp, check that the clamp holes (*Figure 5-135*) correspond to the holes in the mating piece (*Figure 5-137*).

7. Pull the belt to the position shown in (2 in *Figure 5-137*).
8. Tighten both screws (1 in *Figure 5-137* and 1 in *Figure 5-138*). Use Loctite 242 to install the screws.

NOTE:

If a washer (4 in *Figure 5-138*) was installed, it must be removed during installation and may not be reused.

Tighten both screws only after the drift pin is in the correct position.

9. Drive the drift pin in from above (3 in *Figure 5-138*) with a 5-6 mm drift punch and a hammer.

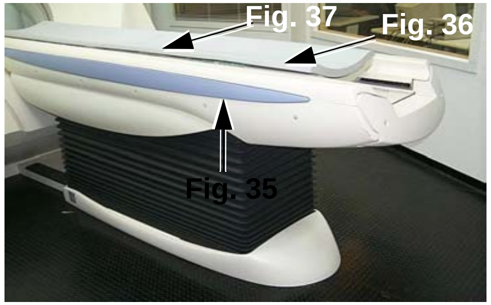


Figure 5-134: Patient Table-rear side view

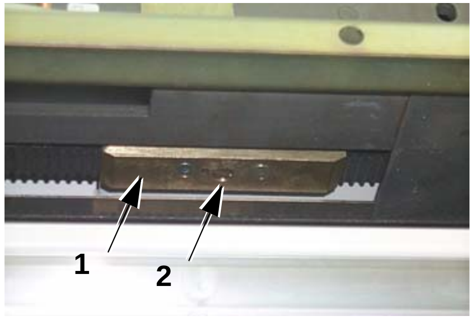


Figure 5-135: Belt Clamp and Clamp Screw

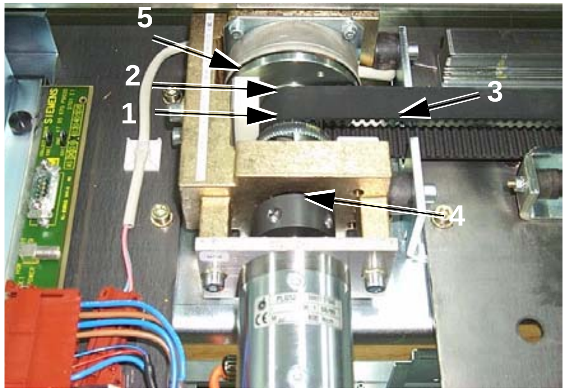


Figure 5-136: Small and Large Belt Placements

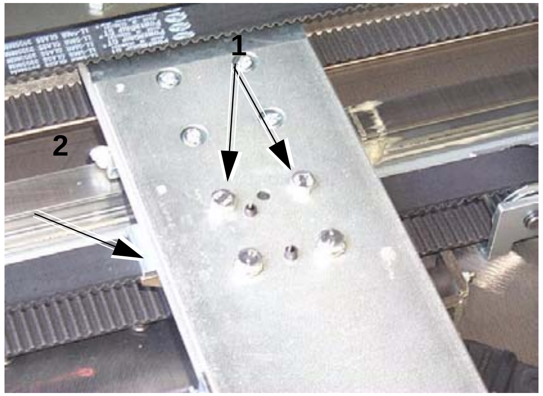


Figure 5-137: Screws and Belt Positions

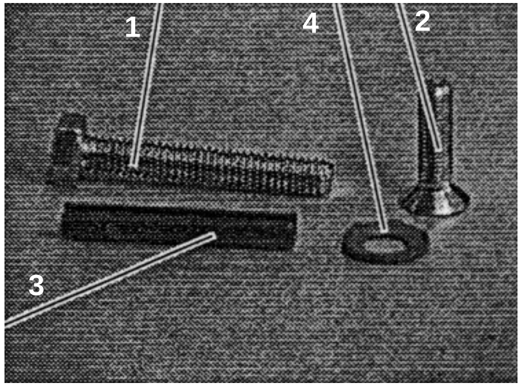


Figure 5-138: Hex Bolt M6 x 35/Countersunk Screw M5 x 20

10. To adjust the belt tension, attach the spring scale via the wire cable in 1 in *Figure 5-140*.

NOTE:

Secure the M5 x 2O screw + nut in the hole above the set screw (1 in *Figure 5-140* and *Figure 5-141*).

11. Set the spring scale to 400 N ± 20 N.
12. Tighten both screws (2 in *Figure 5-141* and 2 in *Figure 5-140*).
13. Adjust the set screw (3 in *Figure 5-141*) up to the end stop and secure it with the nut (4 in *Figure 5-141*).

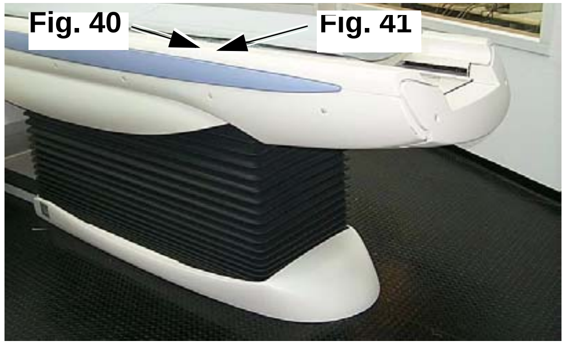


Figure 5-139: Patient Table-rear side view

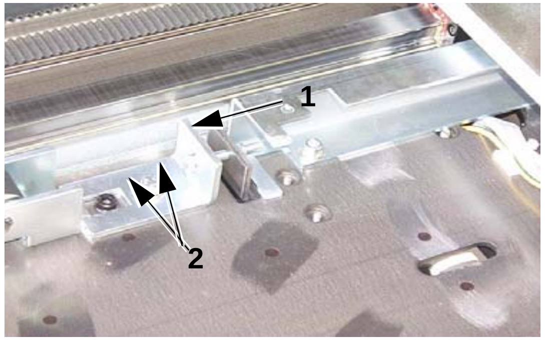


Figure 5-140: Belt Tension Adjustment

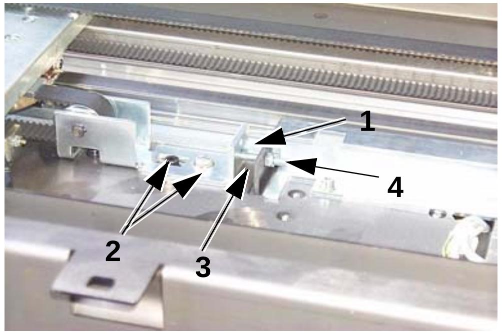


Figure 5-141: Belt Tension Adjustment

Adjustment of Potentiometer R710

To install and adjust the potentiometer, move the table (Top Support) all the way back.

1. Turn the shaft of the potentiometer (*Figure 5-143*) counterclockwise to the end stop.
2. From this position, turn the shaft back in the clockwise direction to 200^{o} (± 10^{o}).

CAUTION

IN THE FOLLOWING STEP, BE CAREFUL NOT TO INADVERTENTLY MOVE THE GUIDE PIN (1 IN *Figure 5-144*).

3. Install the potentiometer on the drive as shown in *Figure 5-144*.

NOTE:

Do not allow the Top Support to move out of the rear position after installing the potentiometer and prior to securing it with the screw (2 in *Figure 5-144*).

4. Apply Loctite 242 to the screw (2 in *Figure 5-144*) and tighten it.
5. Solder the wires back onto the potentiometer.

NOTE:

Do not feed the potentiometer connection cable (I in *Figure 5-145*) as shown in *Figure 5-145*, through the hole of the support block (2 in *Figure 5-145*). This hole is used to attach the spring scale when adjusting the tension of the potentiometer belt.

6. Secure the potentiometer cable with cable ties.

NOTE:

After you power ON the system, but before adjusting the PTH, do the following:

1. Measure the voltage in this Top Support Position (Top Support all the way back) between potentiometer pins 2 (white) and 1 (brown).

2 Release the brake (press EMERGENCY STOP) and push the Top Support all the way back). The value must measure 0.55 V ± 0.2 V.

3 If the value does not fall within the required range, check the setting of the potentiometer shaft again (200° + 10° from the end stop).

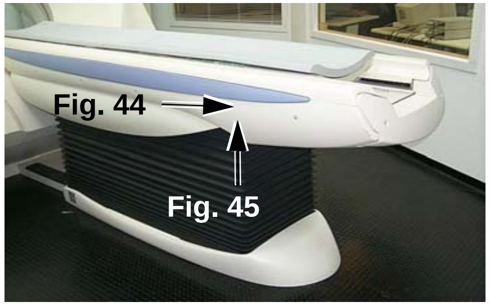


Figure 5-142: Patient Table-rear side view

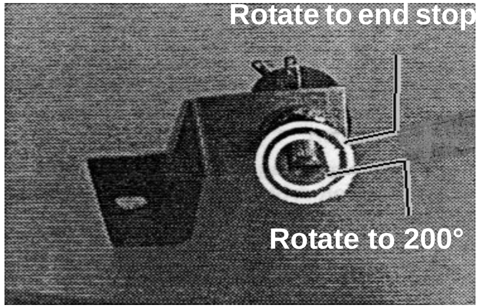


Figure 5-143: Potentiometer R710 Adjustment

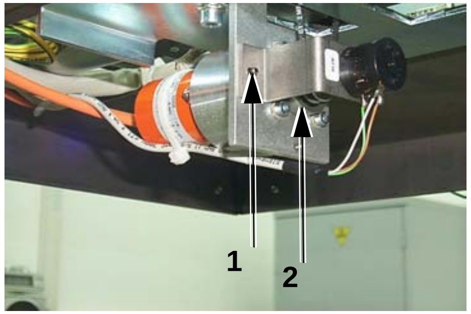


Figure 5-144: Potentiometer Mount Guide Pin

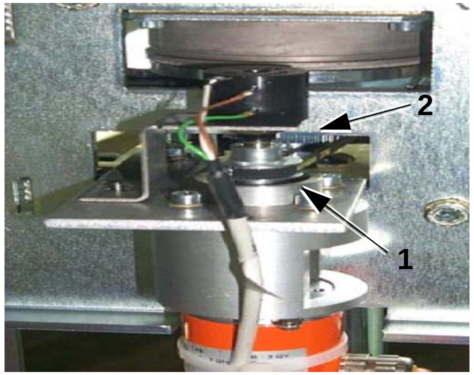


Figure 5-145: Potentiometer Connection Cable and Support Block

7. Before adjusting the PTH, reinstall covers as seen in:
   - — 1 in *Figure 5-118*
   - — 1 in *Figure 5-110*, *Figure 5-113*, *Figure 5-114* and *Figure 5-115*
   - — 2 in *Figure 5-114*

NOTE:

When installing the cover, I in *Figure 5-113*,*Figure 5-114*,*Figure 5-115*, *Figure 5-110*, be sure to align it first on the far right (as seen from the table end facing the Gantry) before tightening it down.

This will prevent problems (error message E3026), caused by the clamp (1 in *Figure 5-126*) of the belt drive rubbing against the left side of the upper table cover (2 in *Figure 5-109*).

Final Steps

1. Perform the PTH adjustment (described in *“Patient Table Horizontal (PTH) Adjustment” on page 5-120*.
2. Perform a Quality Constancy Test in order to check the system performance.

Upper Side Table Covers

Read these instructions completely prior to beginning the replacement.

Follow all procedures for removing and installing the PT Horizontal Board.

Follow Electrostatic Sensitive Devices (ESD) protection guidelines as required.

Use the tools and auxiliary materials recommended in this chapter.

Prior to disconnecting the electrical cables, sketch a diagram of the connections or mark the cables for later identification.

Safety Notes

Follow all general safety guidelines as described in *“Safety Guidelines” on page 1-1*.

Note the special safety guidelines indicated in the instructions in this chapter.

Tighten the screws and nuts using the torque specifically indicated in these instructions. Secure them with the specified Loctite™ if required.

Secure cables with cable ties and/or cable clamps as indicated and ensure that they are connected according to the original configuration.

Required Tools and Auxiliary Materials

- Service tool set
- Feeler gauge
- Small mirror
- Screwdriver M4 with round-head
- Magnetic screwdriver
- Torque wrench 1 - 12 Nm (item number 34 30 063)
- 2.5 Allen wrench
- Loctite™ 242/221

Removing Upper Side Table Covers

1. Move the table to a comfortable work position between 800 and 1,000 (317 to 117 at the Gantry panels) using the corresponding keys on the Gantry operating panel or the service key on the table.
2. Power OFF the system by turning Switch F1 in the PDC OFF.
3. Slide the tabletop forward to the end stop (in the Gantry).
4. Remove both rear covers as indicated by item 1 in *Figure 5-146* and items 1 and 2 in *Figure 5-147*.

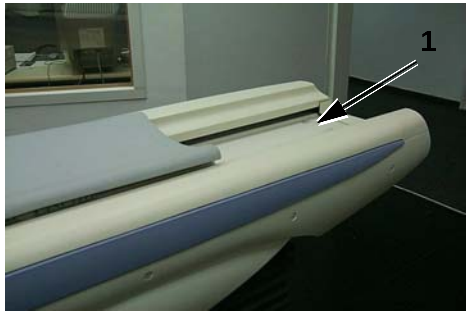


Figure 5-146: Table Covers—side view

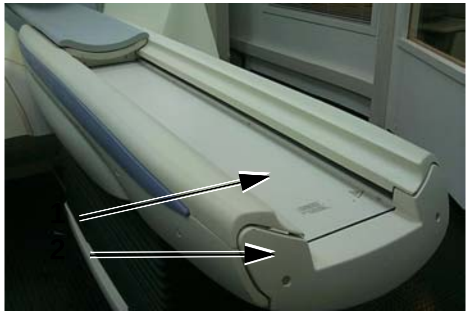


Figure 5-147: Table Covers—rear view

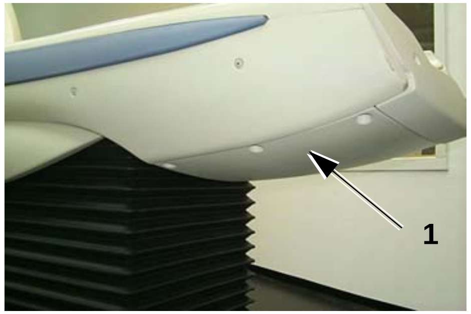


Figure 5-148: Lower Covers

5. Slide the Top Support backward to the end stop.
6. Remove the lower cover (l in *Figure 5-148*) that is located directly behind the bellows.

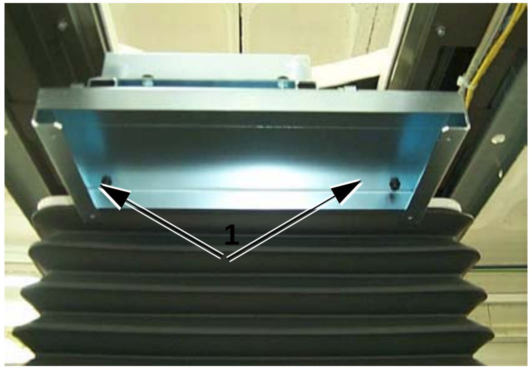


Figure 5-149: Inner Cover

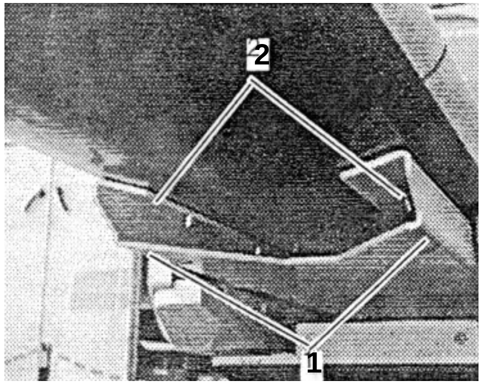


Figure 5-150: Caps and Screws

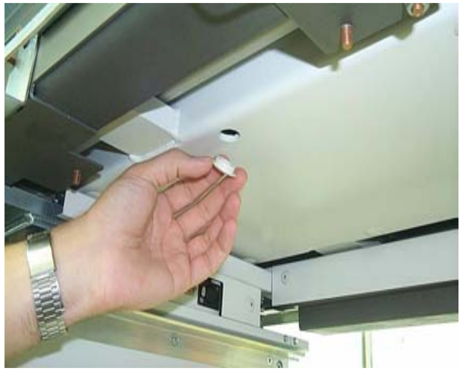


Figure 5-151: Screw Caps

7. Loosen both screws (1 in *Figure 5-143*) and push the support towards the back.
8. Remove the four front caps (1 in *Figure 5-150*) and the screws (2 in *Figure 5-150*) first, then remove the eight rear caps (1 in *Figure 5-151*) and the screws (1 in *Figure 5-151*) from the tabletop (tabletop toward the back).
9. Later during the installation, apply Loctite™ 242 to the screws and tighten them using a force of 6 Nm - 1 Nm.

NOTE:

The caps may be sealed with adhesive. Some force will be required to remove them. Secure the new caps with adhesive.

10. Remove the tabletop.
11. Measure the gap between the table carriage and the side cover to be replaced using a feeler gauge (l in *Figure 5-152*). Record the value.
12. Remove the side covers and switch rails.

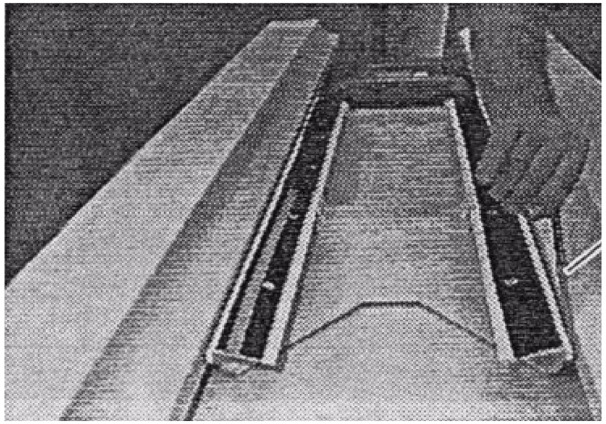


Figure 5-152: Table Carriage Gap Measurement

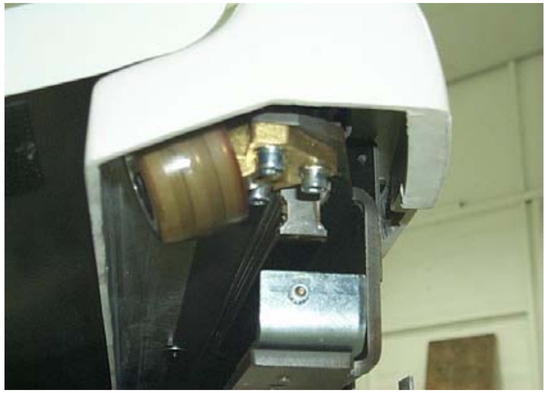


Figure 5-153: Front View

13. Remove the screws (1 in *Figure 5-154*) and remove the bracket.
14. Loosen the screw.
15. Loosen the rear screw on the side cover.
16. Remove the front plates (l in *Figure 5-154*) from both sides.

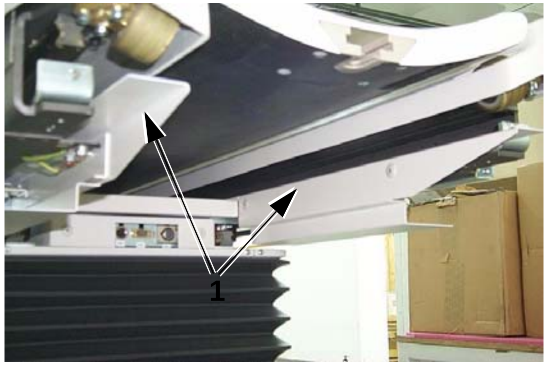


Figure 5-154: Front Plates

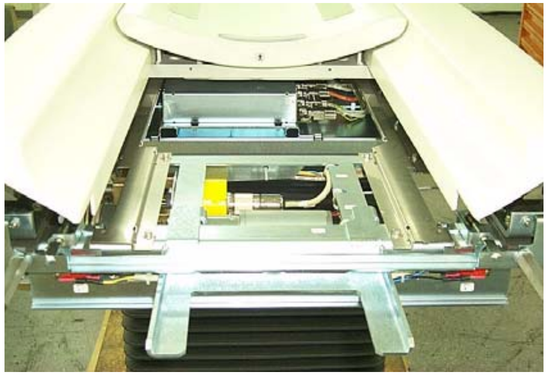


Figure 5-155: Upper Front Cover

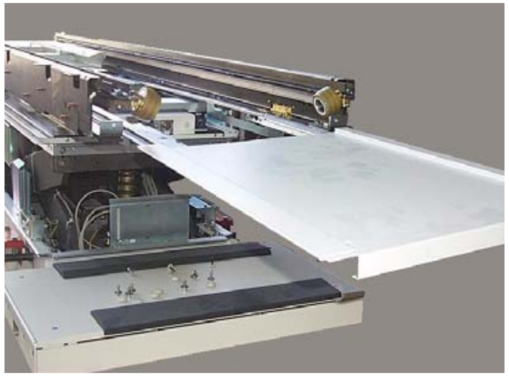


Figure 5-156: Upper Front Cover being removed

17. Remove the upper front cover (1 in *Figure 5-155* and *Figure 5-156*).
18. Loosen the protective conductor and the screws along the entire length of the cover and remove the cover, pulling from the front (*Figure 5-156*).

> **NOTE:**
>
> To do so, see also *“Top Support Drive” on page 5-94*
>
> Ensure that the cover and the corresponding extensions (I in *Figure 5-156* and *Figure 5-157*) are secured with the types and amounts of screws indicated below during reinstallation.
>
> Record which screws were used at which locations.

Table 5-3: Types of screws:

AMOUNT	SCREW TYPE
11	M4 x 8 (hex-head screws)
10	M4 x l0 (Allen screws) + 10 x M4 (nuts)
26	Long cover screws
1	M4 x 8 Allen screw for protective conductor

19. Remove the seven long screws (1 in *Figure 5-158*) on the inside, and seven short screws (1 in *Figure 5-159*) on the outside from the upper side cover.

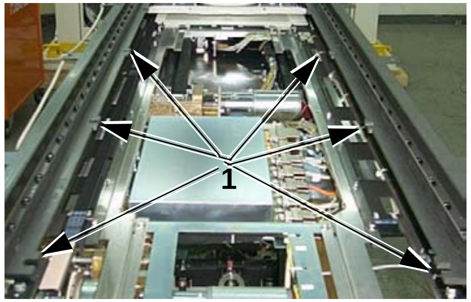


Figure 5-157: Screw Positions

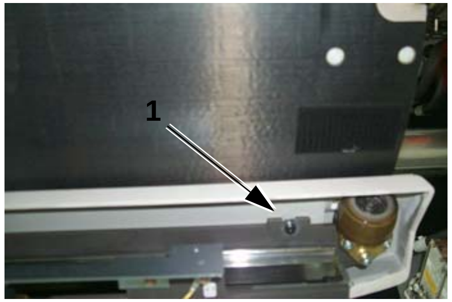


Figure 5-158: Long Screw Position

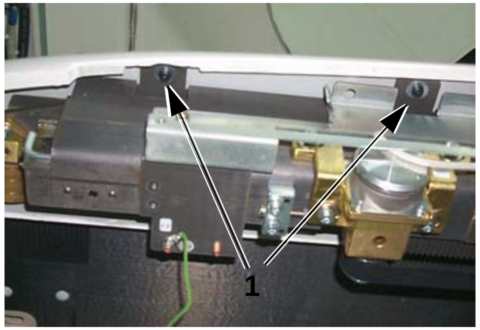


Figure 5-159: Short Screw Positions

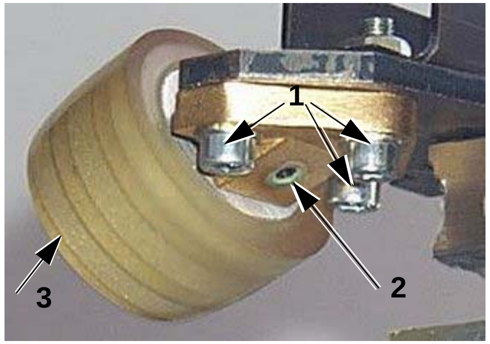


Figure 5-160: Four Screws and Cam (#3)

20. Remove the Side cover.

Installing

Install the table parts by working in the reverse order in which they were removed. Ensure compliance with the following note.

NOTE:

Connect all protective conductors that were disconnected earlier.

Set the distance between the table carriage and cover (l in *Figure 5-152*) as recorded earlier using a feeler gauge when installing the new side cover.

NOTE:

Ensure that the front support rollers can turn.

If there are problems:

- Loosen the three attachment screws (1 in *Figure 5-160*) and move the rollers accordingly.
- If this does not solve the problem, the cam must be adjusted:
  a. Loosen the screw (2 in *Figure 5-160*).
  b. Turn the cam of the support roller using a crescent wrench at location (3 in *Figure 5-160*). Set the minimum gap 0.05 + 0.1 mm between the tabletop and support roller for the entire travel range of the tabletop.

NOTE:

Re-tighten the screws previously loosened as described in the instructions.

Tighten the long/short screws of the side cover (1 in *Figure 5-158* and *Figure 5-159*), primarily the four inner screws that are not easily accessed from below as shown in figures (1 in *Figure 5-160* and *Figure 5-161*).

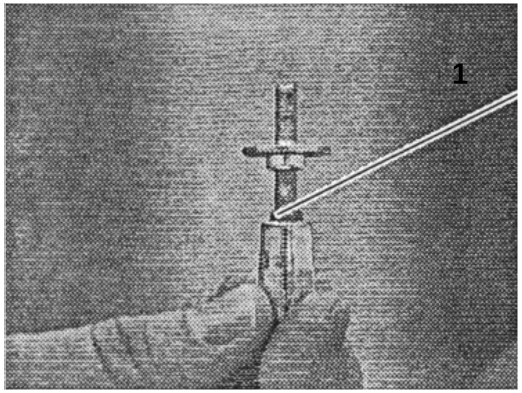


Figure 5-161: Screw in Ratchet Attachment

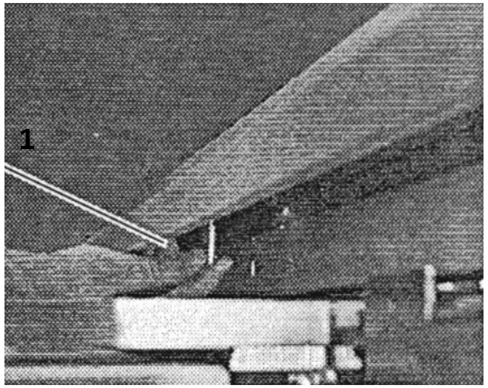


Figure 5-162: Positioning Screw

Place each screw on a corresponding attachment for the small ratchet (1 in *Figure 5-161*). Apply Loctite™ 221 and carefully turn it into the threads.

Use a small mirror to assist in seeing the position of the threaded holes (1 in *Figure 5-162*).

Tighten the screws using a torque of 1.7 ± 0.2 Nm with a torque wrench, wherever space permits.

Use a special screw driver with rounded head (l in *Figure 5-163*) to tighten the lower inner attachment screws of the side cover.

Place the screw to be used directly on the tool and then use the tool to insert and tighten it (1 in *Figure 5-164*).

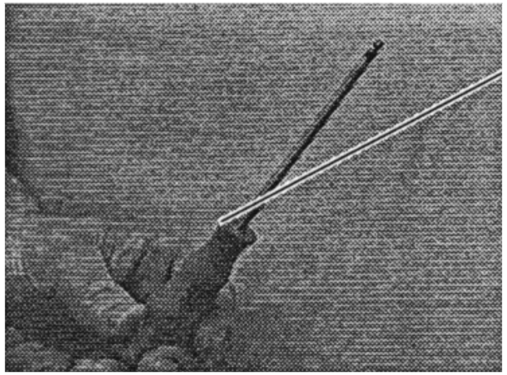


Figure 5-163: Round Head Screwdriver

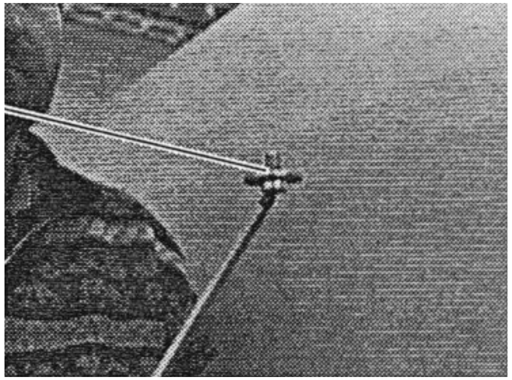


Figure 5-164: Screw on Screwdriver

Final Step

Perform a Quality Constancy Test to check the system performance.

Patient Table Horizontal (PTH) Adjustment

Introduction

This procedure guides the user step-by-step through the horizontal couch calibration process using the CANpro Diagnostic Tool. The parts of the procedure are:

- System Preparation
- Tabletop Adjustment
- Tabletop Support Adjustment
- Verifying Couch Accuracy

Tools Required:

- 2.5mm and 3mm Allen wrenches
- Alignment Pin (see *Figure 5-165*)
- Mechanical Alignment Bar (see *Figure 5-167*)

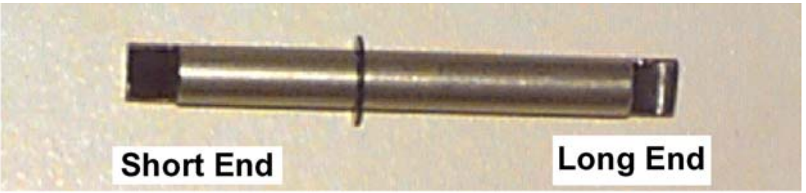


Figure 5-165: Alignment Pin

NOTE:

Use the long end of the Alignment Pin for the table top adjustment. To conveniently store the Alignment Pin when not being used, insert the short end in the Mechanical Adjustment Bar.

Do not activate the rear release switch or the foot switch during the adjustment process. If the adjustment process is interrupted for any reason, repeat the procedure from the beginning.

System Preparation:

1. Position the table vertically until the gantry display reads 125 and then turn power OFF.
2. Remove the Rear Safety Cover from the Patient Table (see *Figure 5-166*).

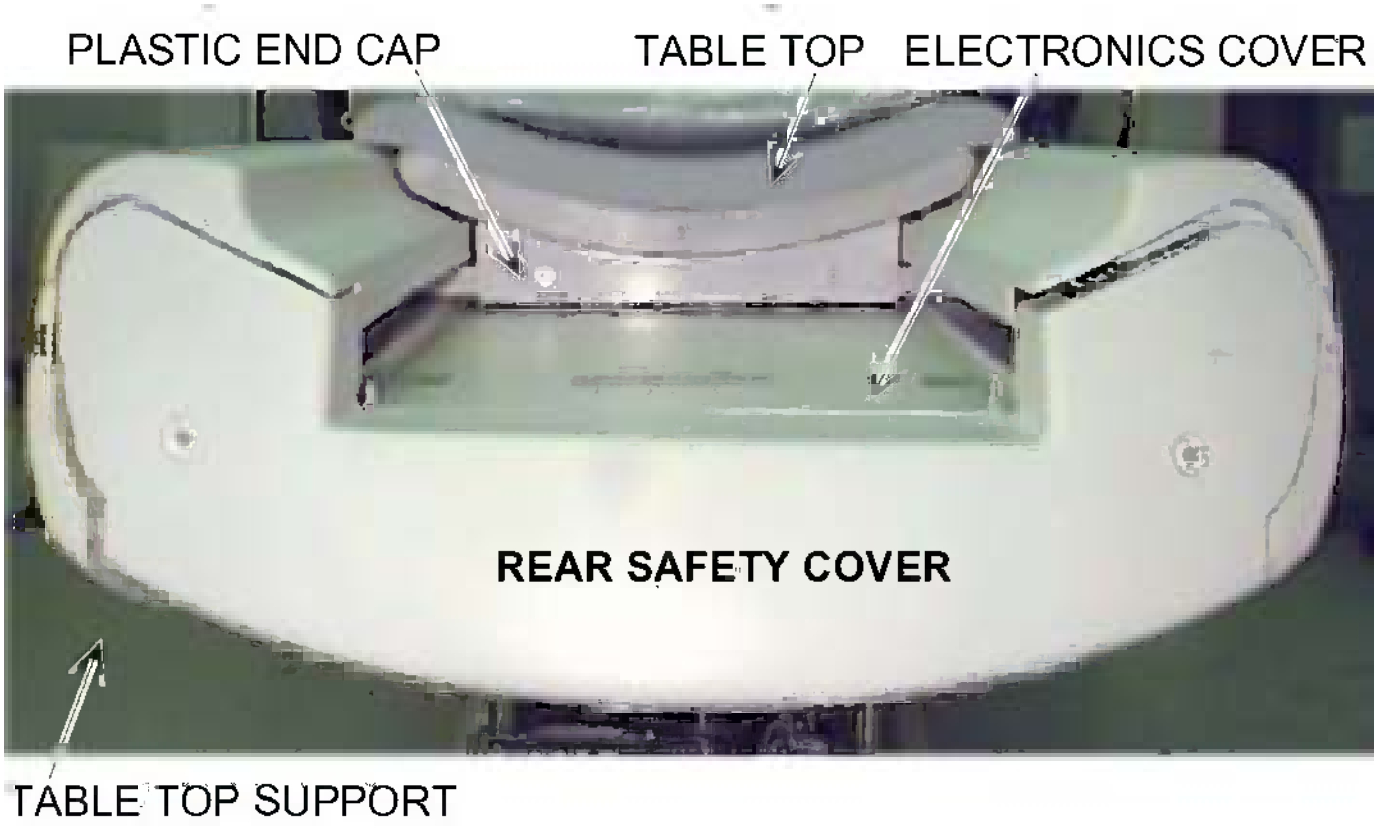

PLASTIC END CAP
TABLE TOP
ELECTRONICS COVER
REAR SAFETY COVER
TABLE TOP SUPPORT

Figure 5-166: Rear Safety Cover

3. Slide the table top in until the six screws holding the electronics cover are visible. Remove the plate that covers the patient table electronics (between the tabletop and tabletop support) and slide the cover out of the table.

4. Move the table top support to its maximum outermost position.
5. Move the table top to the outer adjust position (see *Figure 5-167*).

1-161

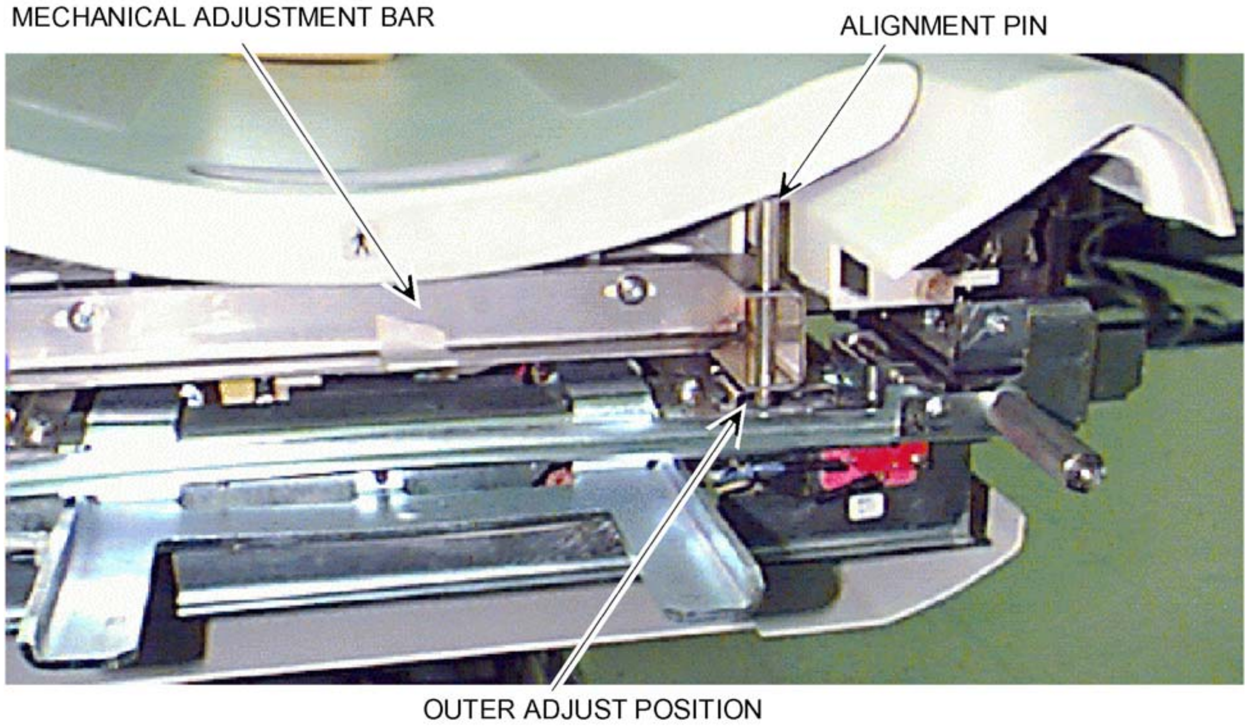


Figure 5-167: Outer Adjust Position

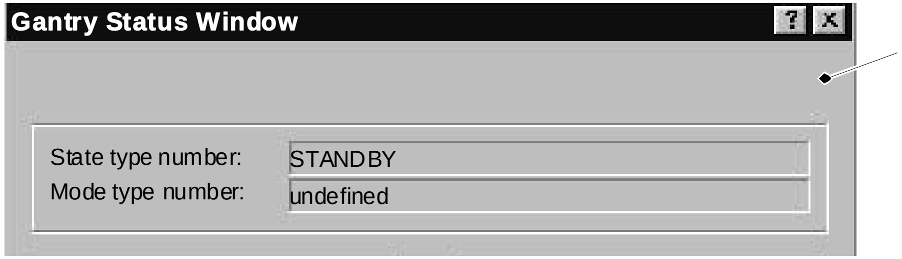
6. Remove the plastic end cap (two screws hold this in position).
7. Mount the mechanical adjustment bar (barely finger-tight) where the plastic end cap was mounted. This allows the bar to be moved left or right.
8. Ensure that the alignment pin is against (and centered with) the outer alignment tab and tighten the screws.
9. After the table is in position, remove the alignment pin. Make sure the Tabletop is in the maximum outermost position.

10. Power up the system.
11. Login as **md** to start the application software.
12. After the Patient Data Screen is displayed, select **Logout** from the **File** menu and **Yes** to log out from the Host.

NOTE:

For CANpro 8/7.5, verify that the scenarios from the host were transferred to the laptop computer (check in the CANpro folder).

13. If CANpro is not already running, start CANpro
    - — For CANpro 8/7.5: Create a new protocol file. From the **File** menu, select **New | Protocol** and click **Create**.
14. Start CANpro monitoring.
15. Verify that the system is in standby:
    - — CANpro 8/7.5: From the **Monitor** menu, select **Gantry Status**. The System state is displayed at the top (see *Figure 5-168*).



State type number: STANDBY
Mode type number: undefined

Function available under Monitor pull-down menu in CANpro 8

Figure 5-168: Gantry Status Window

16. If the system is not in standby, press the Stop button on the CT Box (Scan Control Unit) and select the following Software-dependent actions:
    - CANpro 8/7.5: Click the “Send Reset Telegram” button (upper right-hand side of Toolbar). Watch for the CAN message “Reset Done” and the arrows above the motion control buttons on the CT Box (Scan Control Unit) to light up.

Tabletop Adjustment

1. Load and then start the following scenario:
   - — CANpro 8/7.5: **c:\canpro\machines\"name of site"\scenarios\adjust\phs\Pth_adj.tsc**
2. The system prompts you to “Confirm for premeasurement”. Click **OK.**
3. The system prompts you to “Move table top by hand to the outer adjust position”. Move the table top by hand to the outer adjust position and click **OK.**
4. The system prompts you to “Confirm for the outer position adjust”. Click **OK.**

1-163

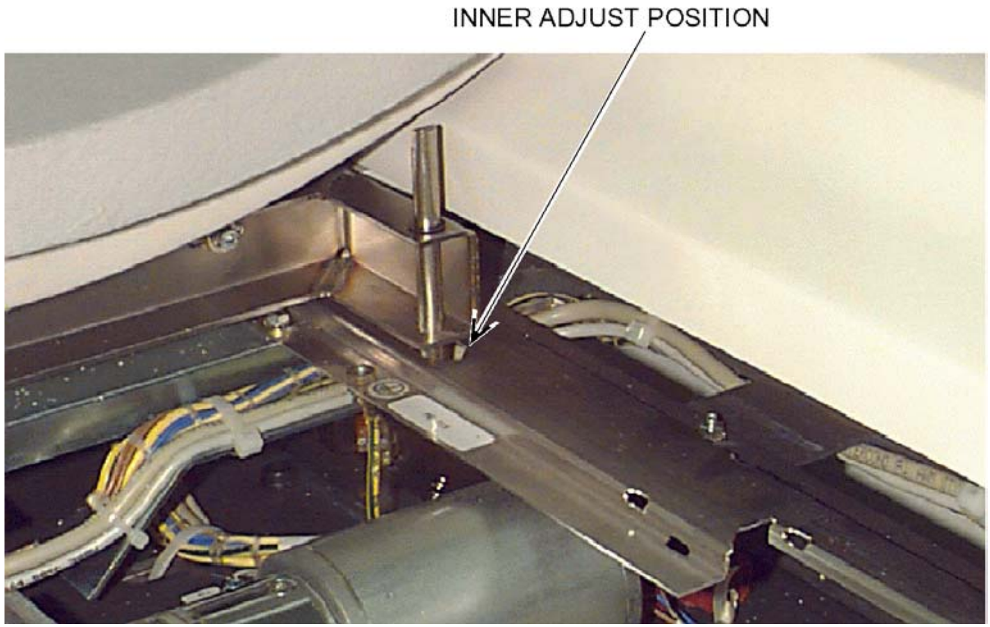


Figure 5-169: Inner Adjust Position

5. The system prompts you to “Move table top by hand to the inner adjust position”. Move the table top by hand to the inner adjust position as shown in *Figure 5-169*. Remove the pin when the table is correctly positioned.

6. Click **OK** to acknowledge the prompt, click **OK** again to “Confirm for the inner position adjust”.
7. The system prompts you to “Move table top by hand to the 7mm position”. Move the table top out as far as possible (maximum outer position). **Do not move the table to 7mm**.
8. Reset the horizontal position by pressing the Zero button (bottom button on the gantry control panel).
9. Move the tabletop by hand until the display reads –7.5mm. Click **OK**.
10. The system prompts you to “Confirm for the tabletop adjust”. Click **OK**.

NOTE:

The program now makes calculations and increments the couch automatically.

11. The system prompts you to “Wait for the LS command from MCU to ICS”.
12. Click **OK** when the LS (Loaded Scan) command from MCU to ICS appears on the CANpro display. Refer to *Figure 5-169*.

NOTE:

The scenario is not finished running at this point in the procedure.

13. Procede to *Section "Tabletop Support Adjustment"*.

Tabletop Support Adjustment

1. The scenario prompts you to “Move the table top support by hand to the outer position”. Move the tabletop support if necessary and click **OK**.
2. The system prompts you to “Confirm for the top support adjust”. Click **OK**.

NOTE:

The program now makes calculations and increments the couch automatically.

3. The system prompts you to “Wait for the LS 0x00 command from MCU to ICS”.
4. Click **OK** when the LS command from MCU to ICS appears on the CANpro display (see Fig. 5-169).
5. The system prompts you to “Open the stop circuit by pressing the STOP button”. Press the STOP button on the CT Box and click **OK**.
6. The system prompts you to “Confirm for flash load”. Click **OK**.
7. The system prompts:
   "Horizontal Couch Calibration finished". Click **OK**.
8. Proceed to *Section "Verifying Couch Accuracy"*.

Verifying Couch Accuracy

1. Cycle power to the Gantry and login as **md**.
2. When the Gantry is in standby, move the Patient Table to its maximum outer position with the Table OUT button on the Gantry Front Cover.
3. Reset the display to zero by pressing the Zero button on the Gantry Front Cover.
4. Move the Patient Table to its maximum inner position with the Table IN button on the Gantry Front Cover.
5. Verify that the Gantry display reads **-2001** mm.
6. Reset the display to zero.
7. Move the Patient Table to its maximum outer position with the Table Out button on the Gantry Front Cover.
8. Verify that the Gantry display reads **2001** mm.
9. Horizontal Couch Calibration is complete.
10. Power down the system.
11. Remove the Mechanical Adjustment Bar and replace all covers.

End of Procedure

Patient Table Vertical (PTV) Adjustment

Introduction

This procedure leads the user through the steps required to set the high and low software limits for vertical motion of the Patient Table. The software limits are only in effect when the Patient Table is in the normal mode of operation. With the Patient Table in the service mode, there are no upper and lower limits to vertical couch motion.

The basic steps in the procedure are:

- Turn on the system
- Position the Patient Table
- Logout
- Gantry to Standby
- Run the calibration scenario
- Reboot the host computer

Required Materials

- Laptop computer with CANpro software loaded and a HyperTerminal shortcut set up for the Mx8000.
- CANpro Security Dongle.
- Peak-CAN Parallel to RS-232 Adapter Dongle.
- Straight Edge long enough to span the width of the Patient TableTop Support and hang over the edge by several inches.
- RS-232 null cable or straight through cable with null adapter for communication with the PTV MCB.

Procedure

System Preparation

1. Power up the Host computer and the Gantry.
2. At the login screen, double-click on the Mx8000 icon.
3. Connect the laptop to the CAN Bus RS-232 cable (from X5 on the MCU MCB) with the security and adapter dongles.
4. Remove the Patient Table sub-frame cover and lift the rubber boot from the side of the sub-frame opposite the gantry (see *Figure 5-170*).

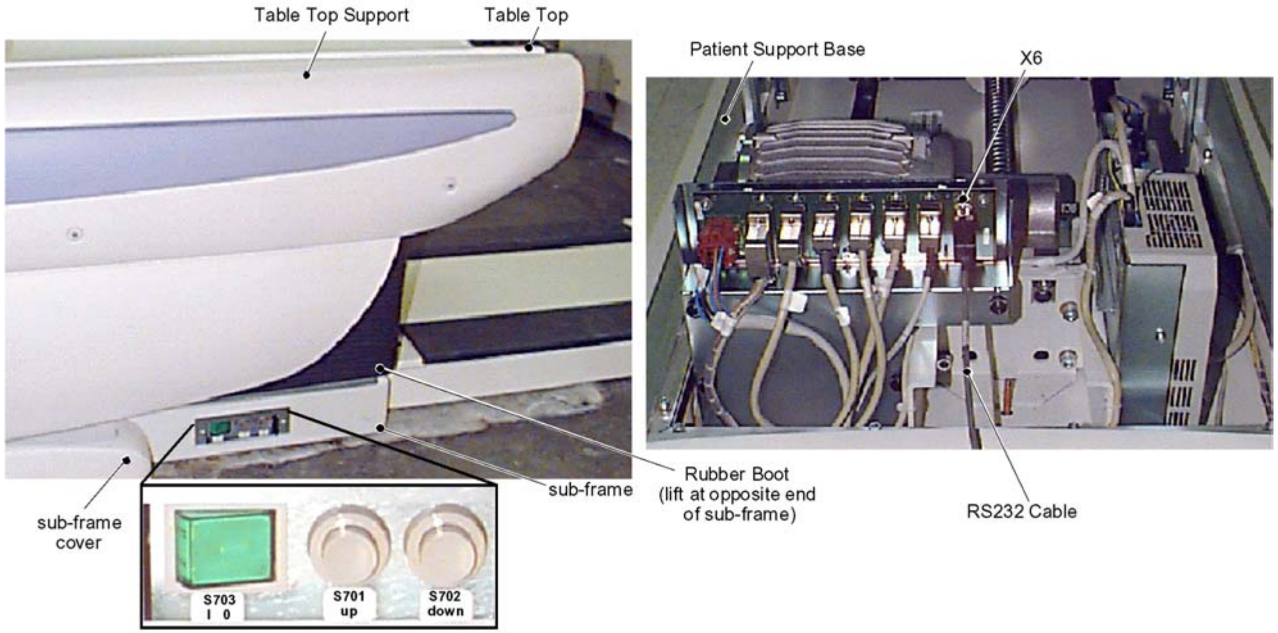


Table Top Support
Table Top
Patient Support Base
X6
sub-frame cover
sub-frame
Rubber Boot
(lift at opposite end
of sub-frame)
RS232 Cable
S703
I 0
S701
up
S702
down

Figure 5-170: Patient Table Base and Controller

5. Open the cover of the PTV controller. (Located in the left rear section of the table base.)

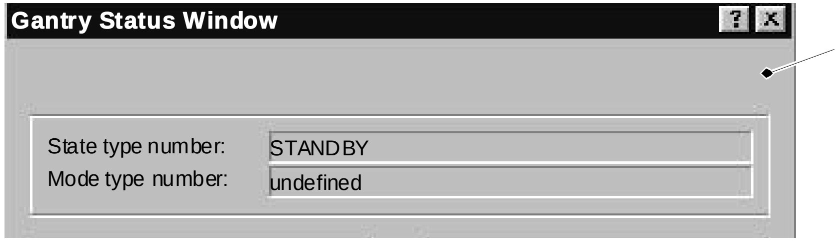
6. Turn on the laptop. When the laptop is booted up, open a Hyperterminal screen:
    a. For a new connection, define a name and select an icon. Click **OK**.
    b. From the **file** menu, click on **properties** (this will open to the “connect to” page).
    c. Make sure the “Connect to” setting is **Direct to Com 1.**
    d. Click on **Configure**.
    e. Make sure the settings read as follows, change if necessary:
        - Bits per second: **9600**
        - Data bits: **8**
        - Parity: **None**
        - Stop bits: **1**
        - Flow control: **Xon/Xoff**

7. Click **OK**.
8. Click on the Settings tab.
9. Make sure that the settings read as follows and change if necessary. Then click **OK**:
    - Emulation: **VT100**
    - Telnet Terminal: **VT100**
    - Backscroll buffer lines: **500**

10. Start CANpro and open a new file with the current date as the file name.
11. Click the **Monitor** menu, make sure **Start** is checked. If not, click **Start** to begin monitoring the CAN Bus.
12. When the Mx8000 scanner is ready (blue progress bar disappears), move the Table Top and Table Top Support to their outermost positions and adjust the Table to a vertical height of 125 mm as read on the Gantry display.
13. From the **File** menu of the Patient Data screen, select **Logout**.

14. Verify that the system is in standby:
    - — CANpro 8/7.5: From the **Monitor** menu, select **Gantry Status**. The system state is displayed at the top (see *Figure 5-171*).
15. If the system is not in standby, perform the following: (Otherwise, continue at step 16).
    a. Press the **STOP** button on the CT Box. This places the system in the stop state.
    b. Reset as follows:
    - — CANpro 8/7.5: Click the “Send Reset Telegram” button (upper right-hand side of Toolbar). Watch for the CAN message “Reset Done” and the arrows above the motion control buttons on the CT Box (Scan Control Unit) to light up.

1-165



State type number: STANDBY
Mode type number: undefined

Function available under Monitor pull-down menu in CANpro 8

Figure 5-171: Send a message on the CAN Bus

> **NOTE:**
>
> Observe the lights on the CT Box. The arrows for controlling the table and gantry motions should be lit when the system is in standby.

    c. Check the system state by repeating step 14.
    d. If the Gantry is still not in standby, continue on with steps 15e) through 15h). Otherwise, continue at step 16.
    e. Bring the system to standby mode by selecting one of the following scenarios:
    —CANpro 8/7.5: **c:\canpro\machines\"name of site"\scenarios\init\INIT_SB.TSC**.

f. Click on Simulation, Start INIT_SB.TSC to run the scenario.
g. You are asked to wait until ID (Init Done) to ICS is complete.
h. Click **OK** when ID to ICS is displayed. Click **OK** at the prompt “Ask for FW-ID’s and perform reset”.

NOTE:

If the system is not in standby after running the scenario, press the STOP button and run INIT_SB.TSC again. Otherwise, reboot the scanner and cycle Gantry power.

16. In CANpro, select “Simulation”, “Load” from the Monitor menu on the toolbar. Select the following scenario and click **OK**:
    — CANpro 8/7.5: **c:\canpro\machines\"name of site"\scenarios\adjust\ PHS\PTVPAR1.TSC**
17. Click **Simulation**. Start scenario PTVPAR1.TSC to run the program.
18. The scenario prompts you to “Connect RS232 cable to PTV x6 and PC computer COM”. Connect one end of the nullRS232 cable (or straight through cable with null adapter) to X6 on the PTV controller board and the other end to Com Port 1 of the laptop (see *Figure 5-170*).
19. Click **OK** to acknowledge the prompt.
20. The scenario prompts you to “open Hyper Terminal window, type CS and Enter”. Double-click on the HyperTerminal shortcut to open communication with the PTV controller. The terminal window usually connects automatically to the PTV. (It should say connected, with an incrementing timer in the lower left corner). If it doesn’t connect automatically, click **CONNECT**.
21. Type the command **CS** to verify connection to the PTV-MCB and click **OK** to acknowledge the prompt.

⚠ **WARNING**

MECHANICAL HAZARD! THE NEXT STEP REQUIRES YOU TO SET THE SERVICE SWITCH S703 TO THE SERVICE POSITION. WITH SERVICE SWITCH S703 SET TO THE SERVICE POSITION, THERE IS NO UPPER AND LOWER HEIGHT LIMIT. THE SCISSORS CARRIAGE CAN BE DRIVEN INTO THE SUB-FRAME. EXERCISE EXTREME CAUTION WHEN RAISING OR LOWERING THE PATIENT TABLE WITH SERVICE SWITCH S703 IN THE SERVICE POSITION. FAILURE TO COMPLY CAN RESULT IN *SERIOUS INJURY OR DEATH* TO SERVICE PERSONNEL OR SERIOUS DAMAGE TO THE EQUIPMENT!

22. The scenario prompts “Couch SERVICE Sw to ON”. Locate the three service buttons on the right front of the table base and switch S703 to the service mode (the “1” position) (see *Figure 5-170*).
23. Click **OK** to acknowledge the prompt.
24. The scenario prompts you to “move the couch UP by SERVICE to 1023mm”. Place a straight edge across the tabletop support at the end of the couch closest to the Gantry. Measuring from the floor to the bottom of the straight edge with a metric tape measure, press switch S701 (UP button) to bring the table up to **1023 mm. Make all measurements from the same location.**
25. Click **OK** to acknowledge the prompt.
26. The scenario prompts you to “Load from Terminal – MAX value”. On the HyperTerminal screen, type: **SV 0** and press **<Enter>**. Click **OK** to acknowledge the prompt.
27. The scenario prompts you to “move the couch DOWN by SERVICE to 480mm”. Press switch S702 (DOWN button) to lower the bed to 480 mm and click **OK** to acknowledge the prompt.
28. The scenario prompts you to “Load from Terminal – MIN velue”. On the hyperterminal screen, type: **SV 1** and press **<Enter>.** Click **OK** to acknowledge the prompt.

NOTE:

If all is well, no error will occur. If an error occurs, return to step 16.

29. The scenario prompts you to “Open the stop circuit by pressing the STOP button”. Press the **STOP** button on the CT Box and click **OK** to acknowledge the prompt.
30. The scenario prompts you to “Confirm OK for flash load Start”. Click **OK** to acknowledge the prompt.
31. The scenario prompts you to “Confirm OK for Flash Load Done”. Click **OK** to acknowledge the prompt.
32. The scenario prompts ”Couch SERVICE Sw to OFF”. Return S703 to normal mode (the “0” position) and click **OK** to acknowledge the prompt.
33. The scenario prompts you to “Confirm OK for Init Start”. Click **OK** to acknowledge the prompt.
34. Double-click on the Shutdown icon. After the host computer is shut down, press the host computer’s ON button.
35. Double-click on the Mx8000 icon to start the application software. The system will re-initialize the Gantry automatically.
36. After the system is booted up and the Gantry is in standby, verify that the vertical range of motion of the couch is:

	GANTRY DISPLAY	**TAPE MEASURE**
Maximum	107	1000mm ± 1%
Minimum	638	480mm ± 1%

NOTE:

The couch is at its lowest position when the Gantry displays the highest number and vice versa.

Since the tolerance of the vertical calibration procedure is +/- 10mm at the highest table position and +/- 5mm at the lowest table position, the Gantry Display may vary from the value in the above table. When verifying the table vertical height calibration, never use the Gantry Display. Always measure from the floor to the bottom of the straight edge and make sure the actual measured height complies with the tolerance without regard to the Gantry Display.

37. Close the HyperTerminal window and remove the laptop connection from the PTV controller if the vertical range of motion is in tolerance.
38. Reinstall the rubber boot and return the Patient Table sub-frame cover to its original position.

End of Procedure

Cleaning of the Couch Vertical Motor Brake

The purpose of this section is to provide the FSE with the following instructions concerning the cleaning of the couch vertical drive spindle/motor brake. Perform this procedure:

- During Periodic Maintenance
- When there is a creaking noise from the spindle/motor brake

Procedure

1. Turn the system ON.
2. Move the couch to its MAX height.
3. Turn the system OFF.
4. Remove the rubber gasket from the right side of the spindle/motor brake as shown in *Figure 5-172*.

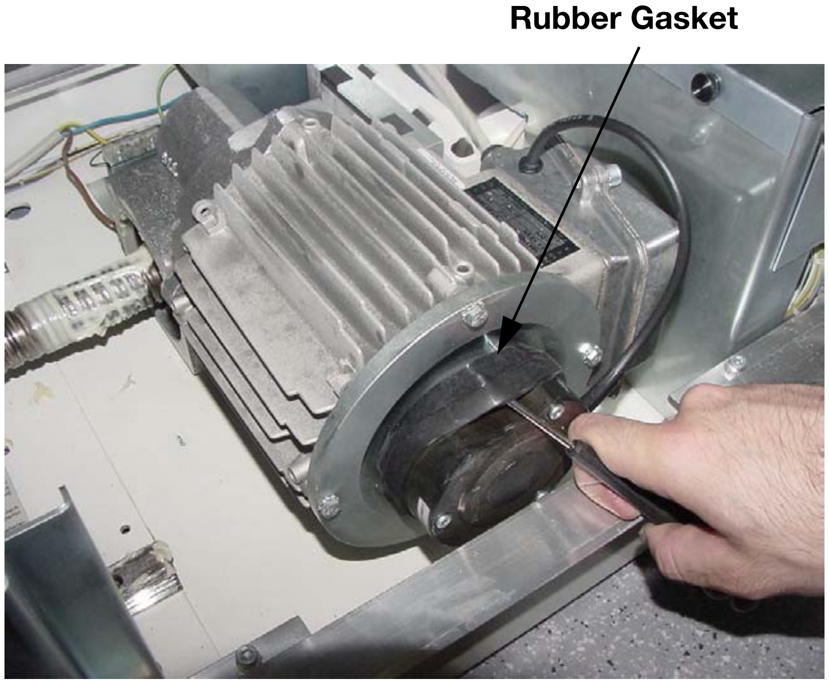


Figure 5-172: Spindle/Motor Brake

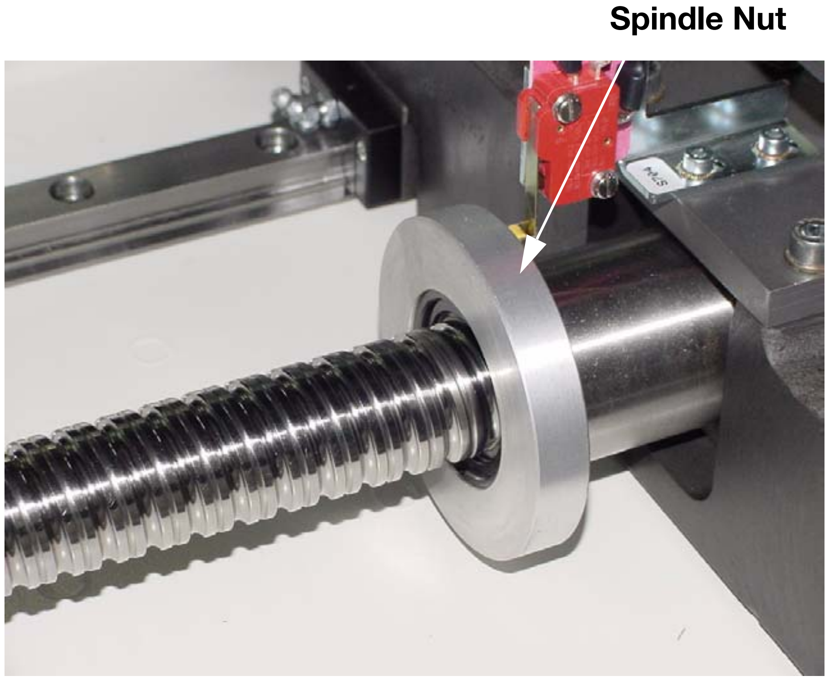


Figure 5-173: Spindle Nut

5. Clean the dust from the spindle/motor brake with a vacuum cleaner.
6. Clean the dust from the spindle nut with a vacuum cleaner.
7. Turn the system ON.
8. Move the couch to MAX down and turn the system OFF.
9. Clean the spindle/motor brake again.
10. Turn the system ON.
11. Verify that there is no noise coming from the spindle/motor brake.
12. Turn the system OFF.

Final Step

Return the rubber gasket to its original position.

Chapter 6
PDC (Power Distribution Cabinet)

Functional Description 6-1

Power Connections 6-1

Direct Current Circuit (DCC) 6-1

Power Distribution System (PDS) 6-3

  Optional Line Compensation 6-3

  Operating Station (Computer Rack) 6-4

  UPS_1 6-4

  Monitor (Second Monitor) 6-4

  DCC Circuit 6-4

  Gantry 6-4

  UPS2 6-5

  Patient Handling System (PHS) 6-6

  Water Cooling System (WCS) 6-6

  Service Sockets (Reserve) 6-6

  Circuit Breaker Control 6-7

  24 V Control Voltage 6-7

PDC Power Control 6-9

  System ON (GANTRY ON) 6-9

  Computer on (Gantry OFF) 6-10

  Computer off (Computer Rack) 6-10

  Service Switch S1 6-11

  Service Switch S2 6-11

Direct Current Circuit (DCC) 6-13

  Capacitor Bank Charging 6-13

  Charge Indicators 6-13

External Connections 6-15

Power supply 6-15

Serial Linked Input Output (SLIO) Board 6-15

Signals 6-16

Functional Description

Power Connections

The scanner requires one external power connection to the input of the Power Distribution Cabinet (PDC).

The input provides:

- Three D-phases with voltages between 380 V and 480 V
- Line frequency of 50 Hz or 60 Hz
- Protective earth

The PDC consists of two sub-components with the following functions:

- Power Distribution System (PDS)—for supplying all system components internally with 230 V (Y), neutral and protective earth
- Direct Current Circuit (DCC)—for supplying the generator with DC-voltage of 565 V (UDC)

Direct Current Circuit (DCC)

The DCC generates a DC voltage of 565 V to supply the inverters in the generator. In the PDC, only the Serial Linked Input Output (SLIO), mounted on the D451 DCC control board, is connected to the Controller Area Network (CAN). Additionally, the D451 receives the X-ray signal from the generator in order to drive the X-ray warning lamp and sends out the Door signal from the door switch to the generator. The Stop-Report-Loop is also looped through the D451.

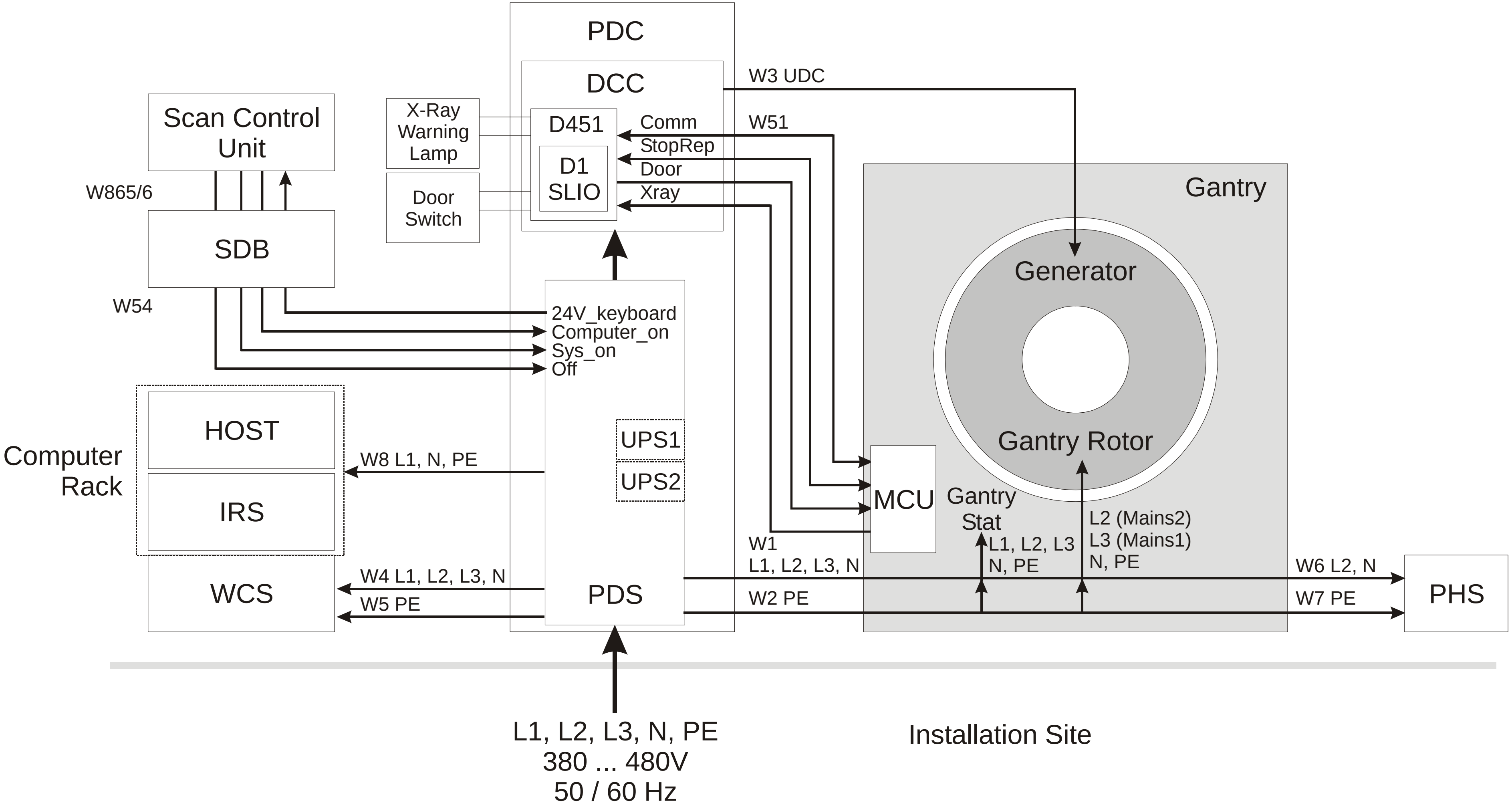

PDC
DCC
W3 UDC
W51
Scan Control Unit
X-Ray Warning Lamp
D451
Comm
StopRep
Door
Xray
D1 SLIO
Door Switch
W865/6
SDB
Gantry
Generator
W54
24V_keyboard
Computer_on
Sys_on
Off
HOST
UPS1
UPS2
Gantry Rotor
Computer Rack
W8 L1, N, PE
IRS
MCU
Gantry Stat
L2 (Mains2)
L3 (Mains1)
N, PE
W1
L1, L2, L3, N
L1, L2, L3
N, PE
W6 L2, N
W4 L1, L2, L3, N
WCS
PDS
W5 PE
W2 PE
W7 PE
PHS
L1, L2, L3, N, PE
380 ... 480V
50 / 60 Hz
Installation Site

Figure 6-1: Power Distribution Cabinet

Power Distribution System (PDS)

The following lines are connected from the PDS:

L1, L2, L3, N, PE	to the Gantry Stationary
L2 L3, N, PE	to the Gantry Rotating
L2, N, PE	to the Patient Handling System (PHS)
L1, N, PE	to the Operating Station
L1, L2, L3, N, PE	to the Water Cooling System (WCS)

The PDS is switched **ON/OFF** using the key switch in the Scan Control Unit with their corresponding signal lines.

- **SYSTEM ON**
- **COMPUTER ON**
- **OFF**

A permanent 24 V line (**24V_keyboard**) is supplied from the PDS for the switching logic in the Scan Control Unit.

The three-phase Mains supply is protected from F200 and connected to the T1 main input-transformer, which converts the variable three-phase input into two fixed output voltages (and has its own Neutral). The output levels are:

- 400 V inter-linked (D) = 230 V single phase to N (U) for the supply of all system components
- 460 V inter-linked (D) for the supply of the WCS pump-motors, only used in case of 60 Hz line frequency

The F1 circuit breaker secures the secondary transformer side output of 400 V(D).

Optional Line Compensation

A line compensation can optionally be installed to improve the cos ϕ of the CT system.

Operating Station (Computer Rack)

The power supply for the Operating Station is derived from the single phase L1 of 230 V through the common circuit breaker, F4. With **SYSTEM ON** or **COMPUTER ON** the K3 relay is energized (see PDC Power Control) and the output is connected through F5 and X254 to the Operating Station.

UPS_1

The optional Uninterruptable Power Supply 1 (**UPS_1**) can be connected between X264 and X265. UPS1 will buffer the Computer Rack components. If the UPS system is not installed, the connection X264 to X265 is closed through standard computer connectors.

Monitor (Second Monitor)

An optional second monitor can be supplied through F21 and X282.

DCC Circuit

During **SYSTEM ON**, relay K5 is energized and the single phase L3 is connected through F10 and X259 internally to the upper located Direct Current Circuit (DCC). Relay K5 is only used there to drive the cooling fan in the DCC section. Additionally, the DCC electronics are supplied, in **SYSTEM ON**, with 24 V, controlled from K5, protected by F12 and connected through the same connector X259 (see PDS Power Control).

Gantry

There are two different power connections to the Gantry from X257:

- Through F8 and the K4 relay (only closed with **SYSTEM ON**), three phases are connected to the Power Supply Station (PSS), in the left Gantry stand. From here, the three phases are distributed to all components in the following:
  - — Gantry Stationary (L1, L2, L3)
  - — Gantry Rotating (L3 = Mains1)

  These voltages are only available with **SYSTEM ON**.

- Additionally, the PSS connects phase L2 (Mains2) through F9 and K9 to the DPU2 (DMS power supply) in the rotating part of the Gantry. This supply is permanently available with the external mains input.

WARNING

ELECTROCUTION HAZARD!! EVEN WITH THE SYSTEM SWITCHED OFF, THERE IS 230 V GENERATED AT THE SLIPRINGS. AS LONG AS THE EXTERNAL POWER SUPPLY OF THE PDC IS ACTIVE, THE DMS POWER SUPPLY IS PRESENT.

UPS2

The optional UPS 2 is connected between X266 and X267. UPS2 will buffer the DMS power supply (DPU2). If the UPS system is not installed, the connection between X266 and X267 is closed through standard computer connectors.

WARNING

ELECTROCUTION HAZARD!! EVEN WITH THE EXTERNAL POWER SUPPLY OF THE PDC SWITCHED OFF, THE UPS2 WILL GENERATE 230 V FOR THE DPU2 BEING PRESENT AT THE SLIPRINGS.

TO SWITCH OFF THIS VOLTAGE, THE SCANNER'S EMERGENCY STOP MUST BE PRESSED (SEE *"PDC Power Control" on page 6-9*)**. IN THIS CASE, FIRST THE EXTERNAL POWER SUPPLY OF THE PDC IS SWITCHED OFF, AND SECOND, K9 DROPS, THUS DISCONNECTING THE ACTIVATED UPS2 OUTPUT.**

Patient Handling System (PHS)

To supply the Patient Handling System (PHS), phase L2 is split in the PDS and just passed through the PSS. F8, K4, F15, and F16 are within this path. F16 is used for the lower voltage power supply in the PHS, and F15 for the spindle motor supply.

The S1 Service Switch, in the service position (indicated through bulb H1), directly connects L2 to the PHS, bypassing K4. This allows table movements with the service push-buttons in the PHS, even in the System-off state. The second contact of S1 interrupts the control line for the K4 and K5 relays, so that powering on of the Gantry and the Generator, using the **GANTRY ON** button in the Scan Control Unit, is not possible (see *“PDC Power Control” on page 6-9*).

⚠ WARNING ⚠

ELECTROCUTION HAZARD!! MAINS2 FOR THE PERMANENT POWER SUPPLY OF THE DMS (DPU2) STILL GENERATES POWER.

Water Cooling System (WCS)

Through circuit breaker F14, three phases are connected to the Water Cooling System (WCS). The phases are used to drive control and logic circuits, in addition to driving the pumps.

The X262 jumper selects the three-phase input voltage (important for the pumps), depending on the Mains frequency as follows:

- 50 Hz: 400 V supply voltage
- 60 Hz: 460 V supply voltage

Service Sockets (Reserve)

The PDS offers two service sockets, protected from F19 and F20 at X280 and X281, as well as a reserve socket, X252, protected from F11. All of the service sockets pass K3 and, thus, are available in the **SYSTEM ON** and **COMPUTER ON** states.

Circuit Breaker Control

The outputs of the PDS are enabled and disabled through the different relays K3-K6. The relays are controlled through the following key switch in the Scan Control Unit.

- **GANTRY ON**
- **GANTRY OFF**
- **OFF** (in the Computer Rack)

24 V Control Voltage

In the PDS, phase L1 (F4, and F3) is used to generate a permanently available control voltage **24V_Keyboard**. This voltage is used to realize the switching of the different relays and, thus, the individual groups of components (see *“PDC Power Control” on page 6-9*).

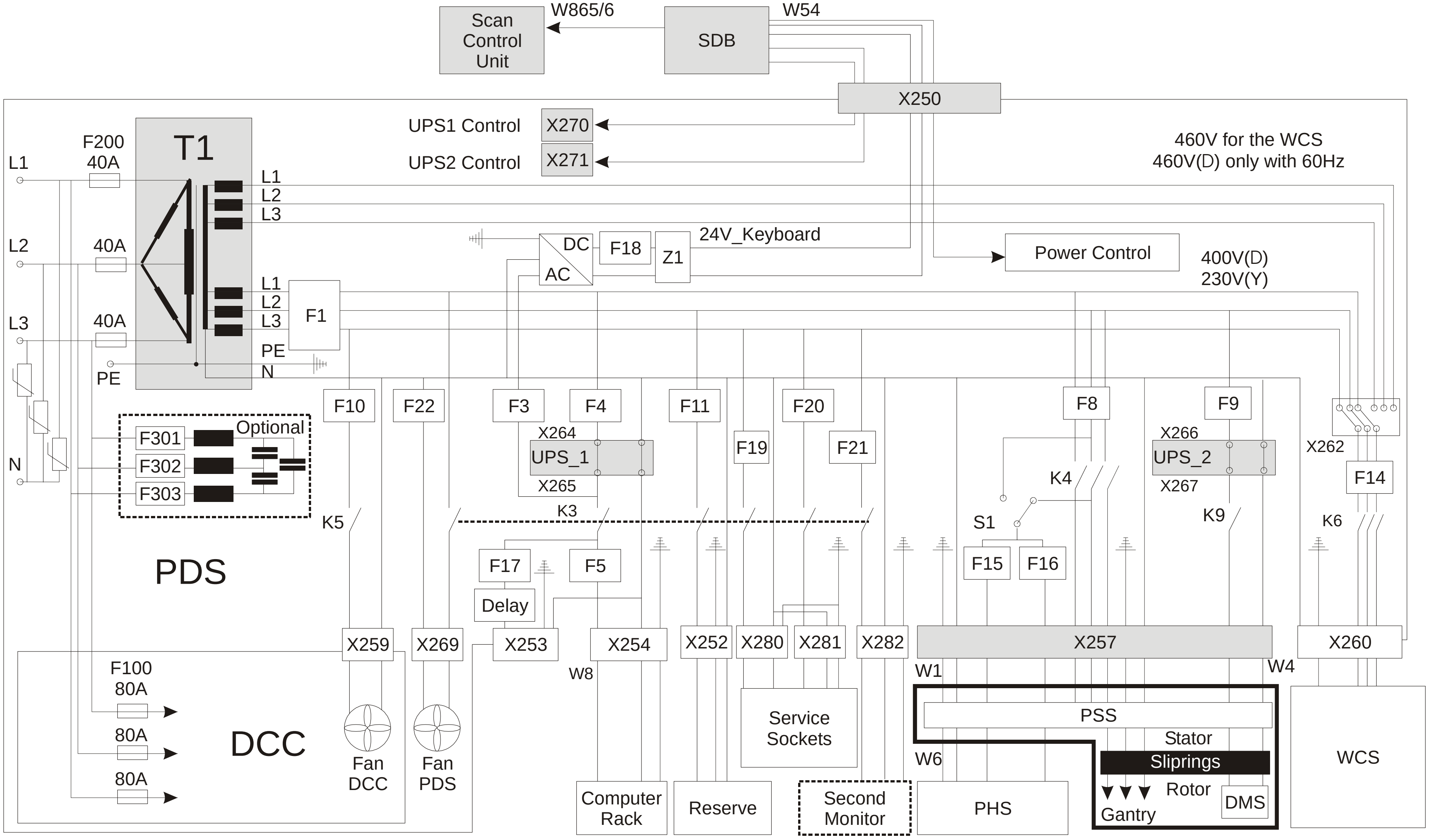

Scan Control Unit
W865/6
SDB
W54
X250
UPS1 Control
X270
UPS2 Control
X271
460V for the WCS
460V(D) only with 60Hz
L1
F200
40A
T1
L2
40A
L3
40A
L1
L2
L3
24V_Keyboard
DC
AC
F18
Z1
Power Control
400V(D)
230V(Y)
L1
L2
L3
F1
PE
N
PE
N
Optional
F301
F302
F303
F10
F22
F3
F4
F11
F20
F8
F9
X264
UPS_1
X265
F19
F21
X266
UPS_2
X267
X262
K4
F14
K5
K3
S1
K9
K6
PDS
F17
F5
F15
F16
Delay
X259
X269
X253
X254
X252
X280
X281
X282
X257
X260
W1
W4
F100
80A
W8
80A
DCC
80A
Fan DCC
Fan PDS
Service Sockets
PSS
Stator
Sliprings
W6
Rotor
WCS
DMS
Gantry
Computer Rack
Reserve
Second Monitor
PHS

Figure 6-2: PDS—Power Connections

PDC Power Control

The PDC is switched from the key switch in the Scan Control Unit and the switch in the Computer Rack.

System ON (GANTRY ON)

If the key switch in the Scan Control Unit is switched to **GANTRY ON**, relay K2 in the PDC is activated and full power is connected to all components via:

- K3 for the Computer Rack power
- K3 to the reserve and service sockets and second monitor supply
- K4 to all Gantry components, except DMS power supply
- K5 to DCC
- K6 to WCS including a potential-free contact to power ON, e.g., an air conditioning unit (COOL)

Results:

- K2 establishes its own selfhold so that K2 stays energized if the key switch is released.
- The potential-free contact to power on a camera (CAM) for the digital documentation on film is closed.
- The LED in the Computer Rack lights up.
- If the system previously was in **COMPUTER ON** state (K1 is energized), then K1 drops and all previous power connections are taken from K2.
- The DMS power supply through K9 is active in all system states.

The system is now ready for use with patients.

Computer on (Gantry OFF)

If the key switch in the Scan Control Unit is switched, relay K1 in the PDC is activated and the following occurs:

- The Computer Rack is powered ON with K3.
- K1 establishes its own selfhold so that K1 stays energized if the key switch is released.
- The potential-free contact for powering ON a camera (CAM) for digital documentation on film is closed.
- The potential-free contact for powering ON a reserve unit (RES) is closed.
- The LED in the Computer Rack lights up.
- If the system previously was in **SYSTEM ON** state (K2 is energized), then K2 relay drops and all other power supplies are switched OFF.
- The DMS power supply through K9 is active in all system states.

The system is now ready for the processing mode.

Computer off (Computer Rack)

The K1 or K2 relays are kept activated with their corresponding self-holding contacts through the **OFF** signal line. Pressing the **OFF** button in the Computer Rack will disconnect K1 and K2 from the **24V_Keyboard**, release K1 and K2 and, thus, disable the power supply for all components except the DMS power supply through K9.

⚠ WARNING ⚠

ELECTROCUTION HAZARD!! EVEN WITH THE SYSTEM SWITCHED OFF, THERE IS A CHARGE OF 230 V AT THE SLIPRINGS. AS LONG AS THE EXTERNAL POWER SUPPLY OF THE PDC IS ACTIVE, THE DMS POWER SUPPLY IS PRESENT.

Service Switch S1

The S1 service switch, in **SERVICE** position (indicated through bulb H1) directly connects L2 to the PHS bypassing K4. This allows table movements, with the service push-buttons in the PHS, even in the **SYSTEM OFF** state. The second contact of S1 interrupts the control line for the K4 and K5 relays, so that powering ON of the Gantry and the Generator, using the **GANTRY ON** switch in the Scan Control Unit, is not possible (see *“PDC Power Control” on page 6-9*). This switch is used during the tube replacement procedure.

WARNING

ELECTROCUTION HAZARD!! THE PERMANENT POWER SUPPLY OF THE DMS (DPU2), THROUGH RELAY K9, STILL GENERATES POWER.

Service Switch S2

The S2 service switch, in **SERVICE** position (indicated through bulb H2) interrupts the control line for the K4 and K5 relays, so that powering ON of the Gantry patient table and the generator, using the **GANTRY ON** button in the Scan Control Unit, is not possible, or will be switched off (same function as second contact of S1).

This switch can be used during service activities at the Gantry, because it inhibits the power up of the whole system with the **GANTRY ON** switch in the Scan Control Unit. As a result, service can be performed safely on those components, while you have unrestricted access to the evaluation mode.

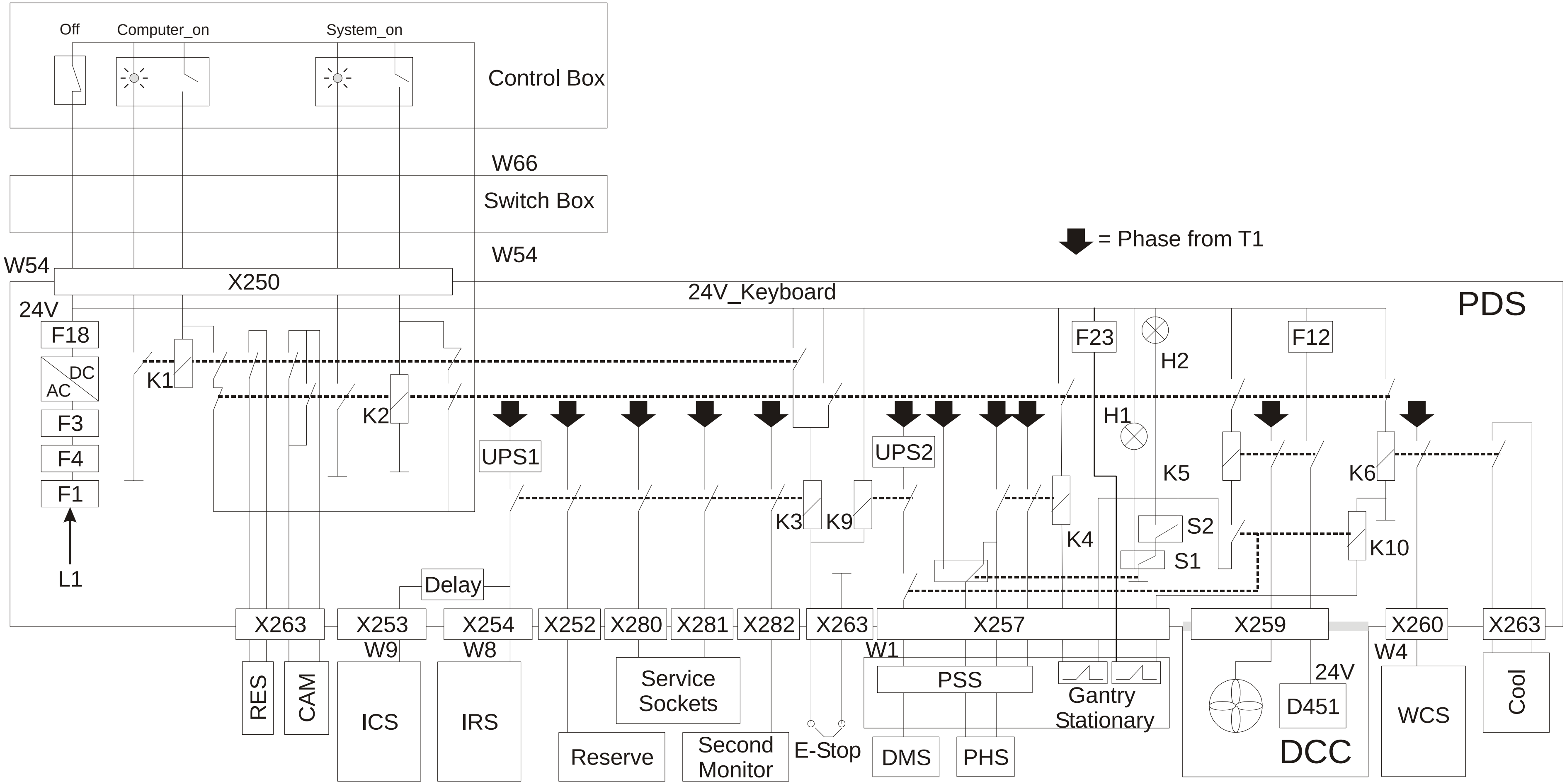

Off
Computer_on
System_on
Control Box
W66
Switch Box
W54
W54
X250
= Phase from T1
24V_Keyboard
PDS
24V
F18
DC
AC
F3
F4
F1
L1
K1
K2
UPS1
UPS2
K3
K9
F23
H2
H1
K4
K5
S2
S1
F12
K6
K10
Delay
X263
X253
W9
X254
W8
X252
X280
X281
X282
X263
X257
W1
X259
X260
W4
X263
RES
CAM
ICS
IRS
Reserve
Service Sockets
Second Monitor
E-Stop
PSS
DMS
PHS
Gantry Stationary
24V
D451
DCC
WCS
Cool

Figure 6-3: PDC and PDS Power Control

Direct Current Circuit (DCC)

The Direct Current Circuit (DCC) generates a fixed DC voltage of 560 V to supply the inverters in the rotating generator. The DCC converts the filtered three-phase AC voltage of 400 V received through F100 and the T1 transformer into a DC voltage of 560 V (**UDC_pos**, **UDC_neg**), using a six-pulse rectifier to charge a capacitor bank (both on D450).

Capacitor Bank Charging

The initial charging of the capacitor bank, after power ON, is controlled from the generator through the CAN bus and the SLIO, using the K2 and K3 relays and the corresponding control signals:

- K2 (Power Relay):**ClosePowerRelay**; **PowerRelayClosed**
- K3 (Charge Relay):**CloseChargeRelay**; **ChargeRelayClosed**

For smooth charging of the capacitor bank, the following occurs after power ON:

- K3 is activated (**CloseChargeRelay**) and only two phases through damping resistors are used to charge the capacitor bank for a fixed time (<1 min). The SLIO receives **ChargeRelayClosed** as an acknowledgment.
- K3 is released and K2 is activated (**ClosePowerRelay**). Then three phases, without a damping resistor between them, charge the capacitor bank to provide full energy for the main inverter. The SLIO receives **PowerRelayClosed** as an acknowledgment.

  The generator monitors the UDC voltage and sends **Reset_done** after power ON, if the UDC level is in tolerance. If the UDC is out of tolerance, the generator sends an error.

- After the successful power ON (**RESET DONE**), the capacitor bank is always charged with three phases (**ClosePowerRelay**), even if a **STOP** occurs or during an **INIT**.

Charge Indicators

Two yellow LEDs on the capacitor bank on D450 indicate if the capacitor bank is charged (ON) or discharged (OFF). The LEDs light up if the voltage exceeds 40 V.

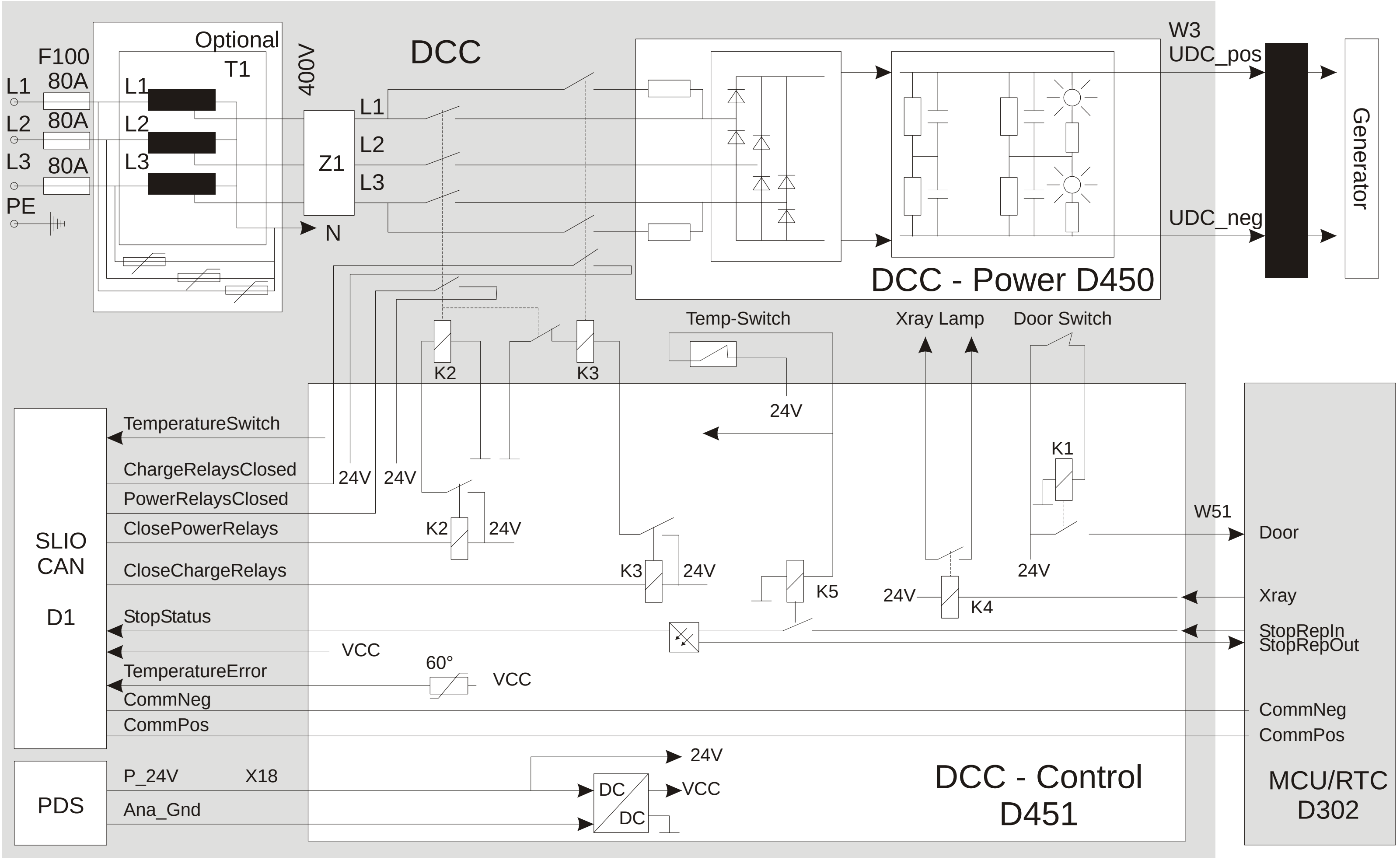

F100
L1
80A
L2
80A
L3
80A
PE
Optional
T1
L1
L2
L3
400V
Z1
N
DCC
L1
L2
L3
W3
UDC_pos
UDC_neg
Generator
DCC - Power D450
Temp-Switch
Xray Lamp
Door Switch
K2
K3
24V
K1
W51
TemperatureSwitch
ChargeRelaysClosed
PowerRelaysClosed
ClosePowerRelays
CloseChargeRelays
StopStatus
TemperatureError
CommNeg
CommPos
24V
24V
K2
24V
K3
24V
K5
24V
K4
24V
SLIO
CAN
D1
VCC
60°
VCC
Door
Xray
StopRepIn
StopRepOut
CommNeg
CommPos
PDS
P_24V
X18
Ana_Gnd
24V
DC
VCC
DC
DCC - Control
D451
MCU/RTC
D302

Figure 6-4: DCC Overview

External Connections

The DCC is included in the Stop Report Loop with contact from the K5 relay on D451 and can interrupt this loop. The relay is controlled from the temperature switch mounted on the optional T1 transformer in the PDS. If the external line voltage is 400 V, and there is no optional T1 installed, the temperature switch connection (X19) is jumpered. The switch and, thus, the Stop Report-Loop will open at temperatures above 170°C (338°F).

The X-ray warning lamp is switched with a potential free contact of the K4 relay on D451. The contact is closed if the X-ray signal from the generator is active, indicating that the high voltage exceeds 20 kV.

With a door switch being opened, D451 sends out the Door signal to the D301 MCU. The MCB of the D301 will immediately block the main inverter and, thus, high tension by removing the **XCEN_MCU** signal (firmware enable for high tension).

At the D451 board there is a temperature sensor to monitor the air temperature in this location. With temperatures above 60°C (140°F) TemperatureError is sent to the SLIO, and from the SLIO to the generator. The generator reacts to this error in the same way as to all other temperature errors, by blocking the main inverter and issuing a fatal error.

Power supply

The D451 gets 24 V from the permanent 24 V power supply (**24V_keyboard**), in the PDS, to generate all required DC voltages. The D451 supplies the SLIO with +5 V (Vcc).

Serial Linked Input Output (SLIO) Board

The Serial Linked Input Output (SLIO) board D1 is mounted on the D451 and serves as connection to the CAN bus. The SLIO board is part of the CAN bus, and is only used to receive commands from the generator (**ClosePowerRelays**, **CloseChargeRelays**) or transmits data (**PowerRelayClosed**, **ChargeRelaysClosed**) or issue errors (**TemperatureSwitch**, **TemperatureError**; **StopStatus**) to the generator.

Signals

TemperatureSwitch

This switch is set if the temperature switch, mounted on the optional T1 transformer, was opened with temperatures above 170°C (338°F). As a result, relay K5 drops and the Stop-Report loop is interrupted.

ChargeRelaysClosed

Feedback to the generator indicating that the charge relay is closed

PowerRelaysClosed

Feedback to the generator indicating that the power relay is closed

ClosedPowerRelays

Request from the generator, sent after **CloseChargeRelays**, to provide full energy for the main inverter. This signal is permanently active after power ON.

CloseChargeRelays

Request from the Generator, sent after power-on for a fixed duration, to close the charge relay for a smooth charging of the empty capacitor bank

StopStatus

Informs the generator about the state of the Stop-Report loop

TemperatureError

Generated if the temperature on D451 exceeds 60°C (140°F). The SLIO transmits this error to the generator, responding with a fatal error.

Door	This signal represents the condition of the door-switch and is used in the MCU D301 to interrupt high tension if the door is opened while scanning.
Xray	This signal is issued from the Generator with high tension above 20 kV and used to drive the X-ray warning lamp.
P_24V	Permanent 24 VDC power supply in the PDS (**24V_keyboard**)
Ana_gnd	Analog ground

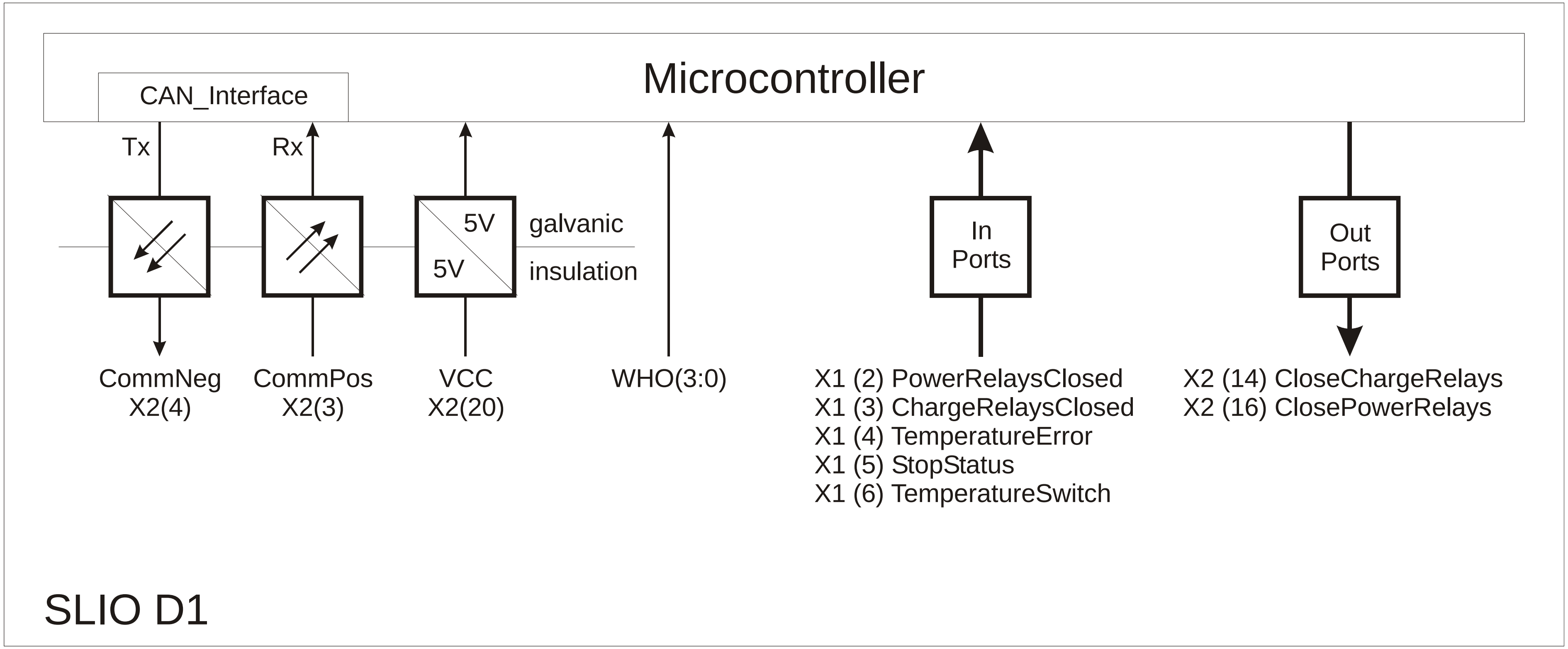

Microcontroller
CAN_Interface
Tx
Rx
5V
5V
galvanic
insulation
In Ports
Out Ports
CommNeg X2(4)
CommPos X2(3)
VCC X2(20)
WHO(3:0)
X1 (2) PowerRelaysClosed
X1 (3) ChargeRelaysClosed
X1 (4) TemperatureError
X1 (5) StopStatus
X1 (6) TemperatureSwitch
X2 (14) CloseChargeRelays
X2 (16) ClosePowerRelays
SLIO D1

Figure 6-5: PDD, DCC and SLIO

The Serial Linked Input Output (SLIO) board D1 is mounted on the D451 and serves as a connection to the CAN bus. The SLIO is a member of the CAN bus and can only be used to receive commands from the generator (ClosePowerRelays, CloseChargeRelays), transmission acknowledgements (PowerRelaysClosed, ChargeRelaysClosed) or transmit errors (TemperatureSwitch, Temperature Error, StopStatus) to the generator. The SLIO address is hard-wired by its plug-in location.

Chapter 7
WCS

Functional Description 7-1

Water Cooling System (WCS) Types 7-1
Water-Water Cooling Unit 7-1
Water-Air Cooling Unit 7-1
Water-Water Cooling Unit 7-2
Water-Water Cooling Unit Water Circuit 7-5
Water-Water Cooling Unit Electrical Circuit 7-8
Water-Air Cooling Unit 7-12
Water-Air Cooling Unit Water Circuit 7-14
Water-Air Cooling Unit Coolant Circuit 7-16
Water-Air Cooling Unit Air Flow 7-19
Water-Air Cooling Unit Electrical Circuit 1 7-21
Water-Air Cooling Unit Electrical Circuit 2 7-27

Parts Replacement 7-29

Water-Water Cooling System Overview 7-31
Water-Air Cooling System Overview 7-32
Draining and Filling the Cooling System 7-33
Draining the Cooling System 7-33
Draining Process 7-34
Additional Procedures 7-35
Filling the Water Cooling System 7-37
Final Steps 7-42
Checking the Correct Pump Rotation in the Water Cooling System (WCS) 7-43
Replacing the Permanent Bleeding Valve (Water-Water only) 7-44
Removing the Valve 7-44
Installing the Valve 7-45
Final Steps 7-46
Coolant System (Water-Air only) 7-47
Spirovent Bleeding Device 7-48
Removing the Bleeding Device 7-48
Installing the Bleeding Device 7-49
Final Steps 7-50
Temperature Sensor 7-51
Removing the Temperature Sensor 7-51
Installing the Temperature Sensor 7-52
Final Steps 7-52
Adjustment Drive in the WCS (Water-Water only) 7-53
Removing the Adjustment Drive 7-53
Installing the Adjustment Drive 7-55
Final Steps 7-55
3-way Valve (Water-Water only) 7-56
Removing the 3-way Valve 7-56
Installing the 3-way Valve 7-57
Final Steps 7-58
Cooling Pump 7-59
Removing the Cooling Pump 7-59

- Installing the Cooling Pump 7-61
- Final Steps 7-61
- Checking the Correct Pump Rotation in the Water Cooling System (WCS) 7-62

Expansion Reservoir 7-63

- Removing the Expansion Reservoir 7-63
- Installing the Expansion Reservoir 7-65
- Final Steps 7-65

Flow Sensor (Water-Water only) 7-66

- Removing the Flow Sensor 7-66
- Installing the Flow Sensor 7-67
- Final Steps 7-67

Filling and Draining Valve 7-68

- Removing the Filling and Draining Valve 7-68
- Installing the Filling and Draining Valve 7-69
- Final Steps 7-69

Shut-off Valve 7-70

- Removing the Shut-off Valve 7-70
- Installing the Shut-off Valve 7-71
- Final Steps 7-71

Temperature Sensor in the Air Inlet (Water-Air only) 7-72

- Removing the Temperature Sensor 7-72
- Installing 7-73
- Final Steps 7-73

Fan (Water-Air only) 7-74

- Removing the Fan 7-74
- Installing the Fan 7-76
- Final Steps 7-77

Functional Description

Water Cooling System (WCS) Types

The function of the Water Cooling System (WCS) (*Figure 7-1*) is to cool the Gantry. The heat from the Gantry is discharged by a Water-Water Cooling Unit or a Water-Air Cooling Unit, depending on the site requirements (see *Figure 7-2*).

The Gantry has a closed housing, and therefore, there is no air exchange between the inside and outside. The thermo-energy is picked up by heat exchangers inside the Gantry. The Gantry water circuit operates with a fixed cold water temperature of 17.5°C to 19.5°C (63.5°F to 67.1°F) and a flow of 3,000 l/hr (liters/hr) (792.516 gal/hr).

Water-Water Cooling Unit

The thermo energy is discharged by the Water-Water Cooling Unit to a closed loop cooling system of the installation site. The temperature of the incoming cold water supply should be 2°C to 16°C (35.6°F to 60.8°F). The nominal power of the cooling unit is 13.5 kW.

Water-Air Cooling Unit

The thermo energy is discharged by the Air-Water Cooling Unit to the ambient air. The temperature of the incoming air should be -25°C to +40°C (-13°F to +104°F). The nominal power of the cooling unit is 13.5 kW.

Water-Water Cooling Unit

Table 7-1 describes the components of the Water-Water Cooling Unit and their functions.

Table 7-1: Water-Water Cooling Unit Components

COMPONENT	FUNCTIONAL DESCRIPTION
Radial Fans	Three radial fans draw the air through an oil-air heat exchanger, C-box and a circular air duct between the stationary and rotating part of the Gantry. From here, the fans blow the air through three air-water heat exchangers back into the Gantry.
Gantry	The Gantry has a closed housing, and therefore no air exchange exists between the inside and outside. The thermo-energy is absorbed by heat exchangers inside the Gantry. There is an additional oil cooling circuit for the X-ray tube. The Gantry water circuit operates with a fixed cold water temperature of 17.5°C-19.5°C (63.5°F-67.1°F) and a flow of 3,000 1/h (792.516 gal/hr).
Mixer	A mixer valve inside the right Gantry stand maintains the air temperature at 26°C-30°C (78.8°F-86°F).
Water -Water Cooling Unit	The thermo energy is discharged by the Water-Water cooling Unit to a closed loop cooling system of the installation site. The temperature of the incoming cold water supply should be 2°C-16°C (35.6°F-60.8°F). The nominal power of the cooling unit is 13.5 kW.

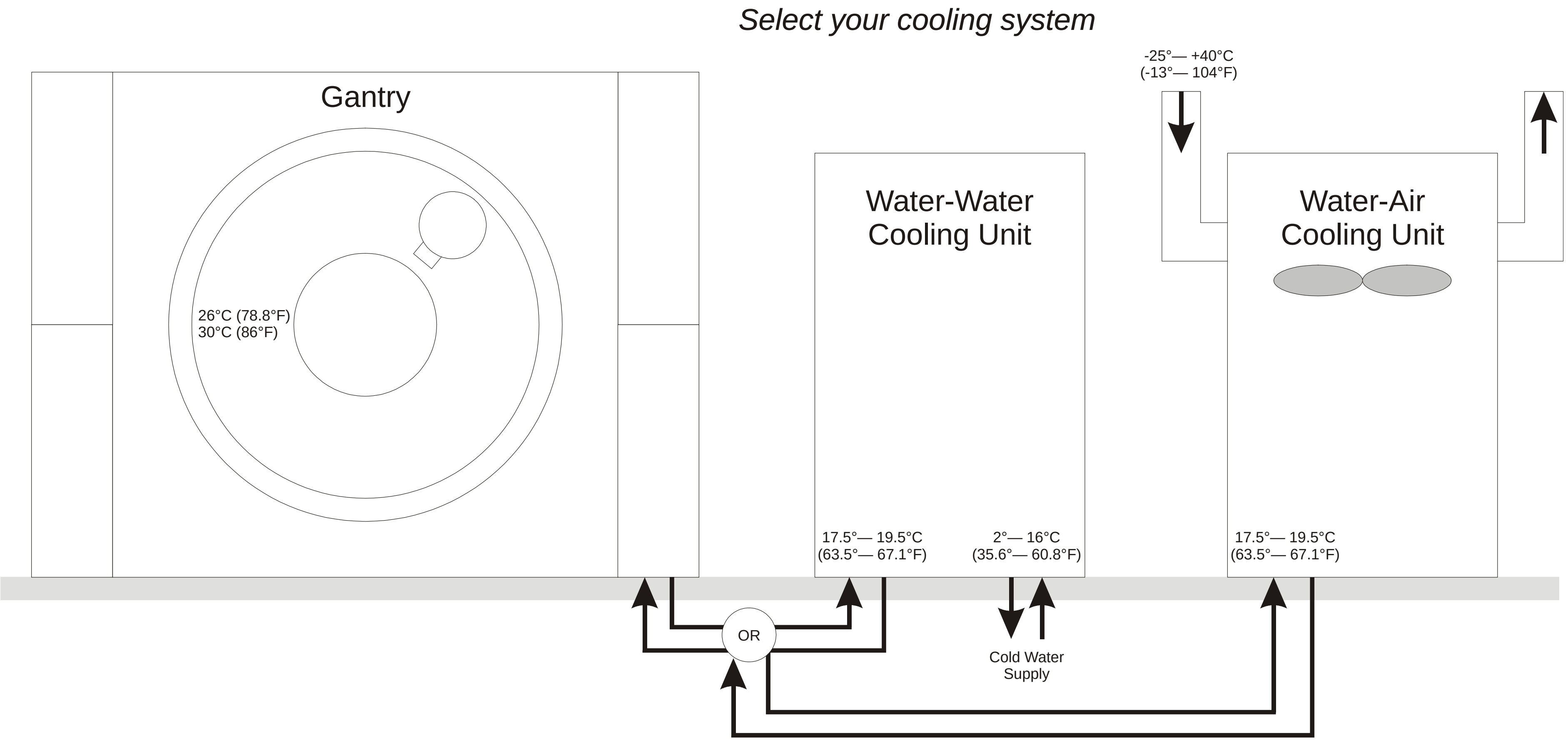

Select your cooling system
Gantry
26°C (78.8°F)
30°C (86°F)
Water-Water
Cooling Unit
17.5°— 19.5°C
(63.5°— 67.1°F)
2°— 16°C
(35.6°— 60.8°F)
Cold Water
Supply
OR
-25°— +40°C
(-13°— 104°F)
Water-Air
Cooling Unit
17.5°— 19.5°C
(63.5°— 67.1°F)

Figure 7-1: WCS (Water Cooling System)

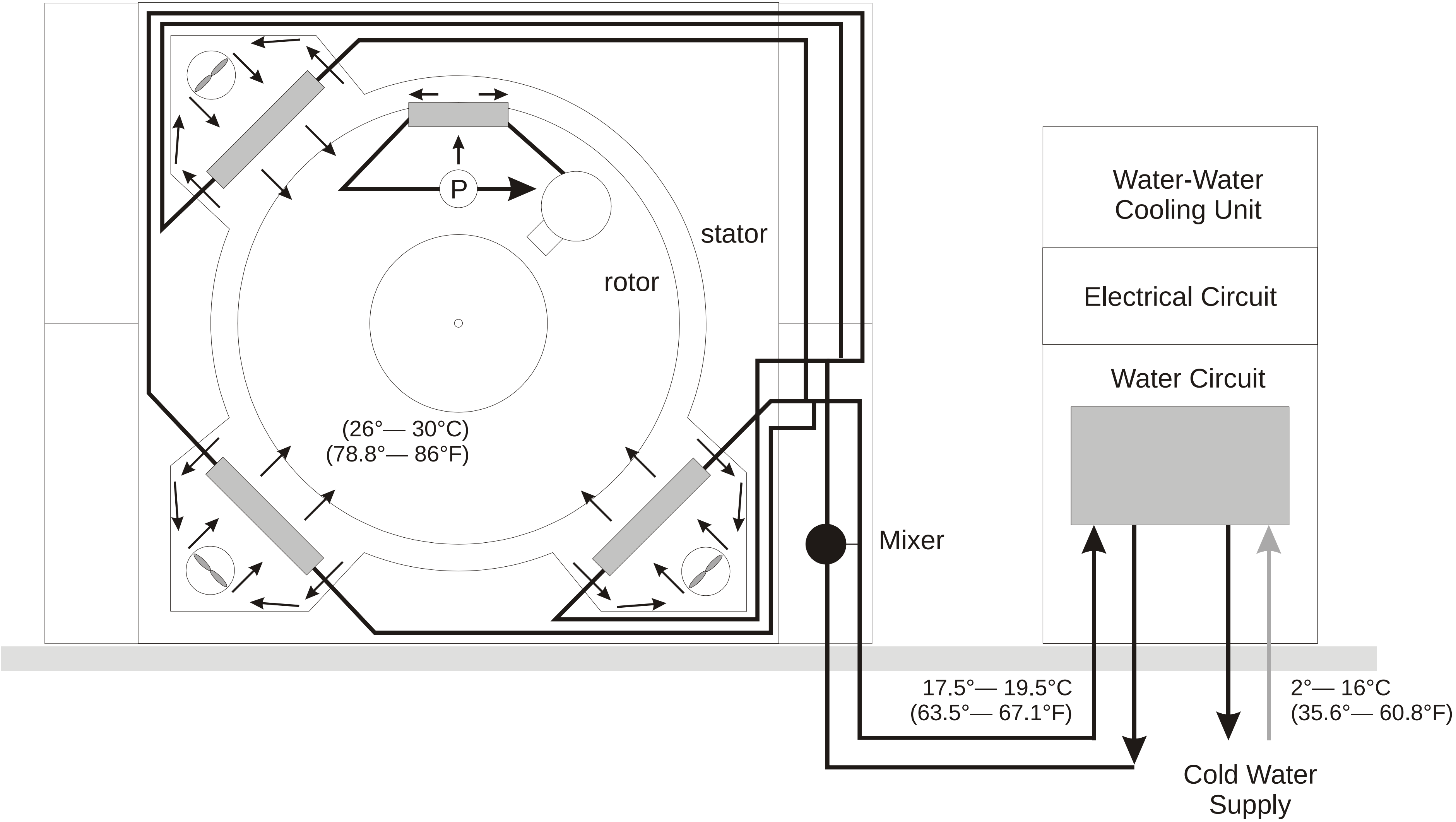

P
stator
rotor
(26°— 30°C)
(78.8°— 86°F)
Mixer
Water-Water
Cooling Unit
Electrical Circuit
Water Circuit
17.5°— 19.5°C
(63.5°— 67.1°F)
2°— 16°C
(35.6°— 60.8°F)
Cold Water
Supply

Figure 7-2: Water-Water Cooling Unit

Water-Water Cooling Unit Water Circuit

The following table describes the function of the water-water water circuit (*Figure 7-3*), which is directly connected to the cooling circuit of the system The heated water of the Gantry flows through the heat exchanger and is cooled down to a temperature of 17.5°C-19.5°C (63.5°F to 67.1°F) and is then again supplied to the Gantry. The water-water water circuit consists of the components listed in *Table 7-2*.

Table 7-2: Water-Water WCS Water Circuit Components

COMPONENT	DESCRIPTION
Cooling Water-In	The temperature of the incoming cold water supply should be 2°C to 16°C (35.6°F to 60.8°F). The required flow rate is conversely proportional to the temperature. The nominal power of the cooling unit is 13.5 kW.
Pressure Gauge	The pressure gauge is used to check the water pressure of the Gantry water circuit or the hospital cooling water circuit. The initial set point of the Gantry water circuit is 2.2 bars (31.908 psi), if the cooling unit is switched OFF, i.e., without water flow. The maximum pressure of the hospital cooling water should be 10 bar (145.037 psi).
R2	The temperature of the cooling water inlet is measured by the Water Cooling Control (WCC) via the R2 probe (NTC). This value is monitored for service purposes.
Filling and Draining Valves	These water valves are used to fill or empty the water circuit. Filling of the Gantry water circuit must be done very slowly to prevent damage of the vent valve, heat exchanger and pipes of the water circuit. The initial filling procedure should take approximately 15 minutes.
Stop valve	The stop valve is used to close the water circuit during flushing of the cooling unit.
Expansion reservoir	The expansion reservoir is needed to prevent excessive pressure in the water circuit due to temperature changes of the water. The volume of the vessel is divided by a membrane into two sections. One section is filled with pressurized nitrogen, and the other is filled with water.
Vent valve	The ventilation valve automatically discharges air in the water circuit.
Manual Vent valve	The manual ventilation valve discharges air in the water circuit if the valve is opened.

Table 7-2: Water-Water WCS Water Circuit Components

COMPONENT	DESCRIPTION
Three-Way Valve	The regulation of the water temperature is done by using the three-way valve. This valve splits the water flow coming from the Gantry to the heat exchanger inlet and outlet. At the heat exchanger outlet the cold and warm water are mixed in order to generate a temperature of 17.5°C-19.5°C (63.5°F-67.1°F).
R1	The temperature of the mixed water is measured by the Water Cooling Control (WCC) regulator via the R1 probe (NTC). This feedback is then used to regulate the water temperature through the position of the three-way valve.

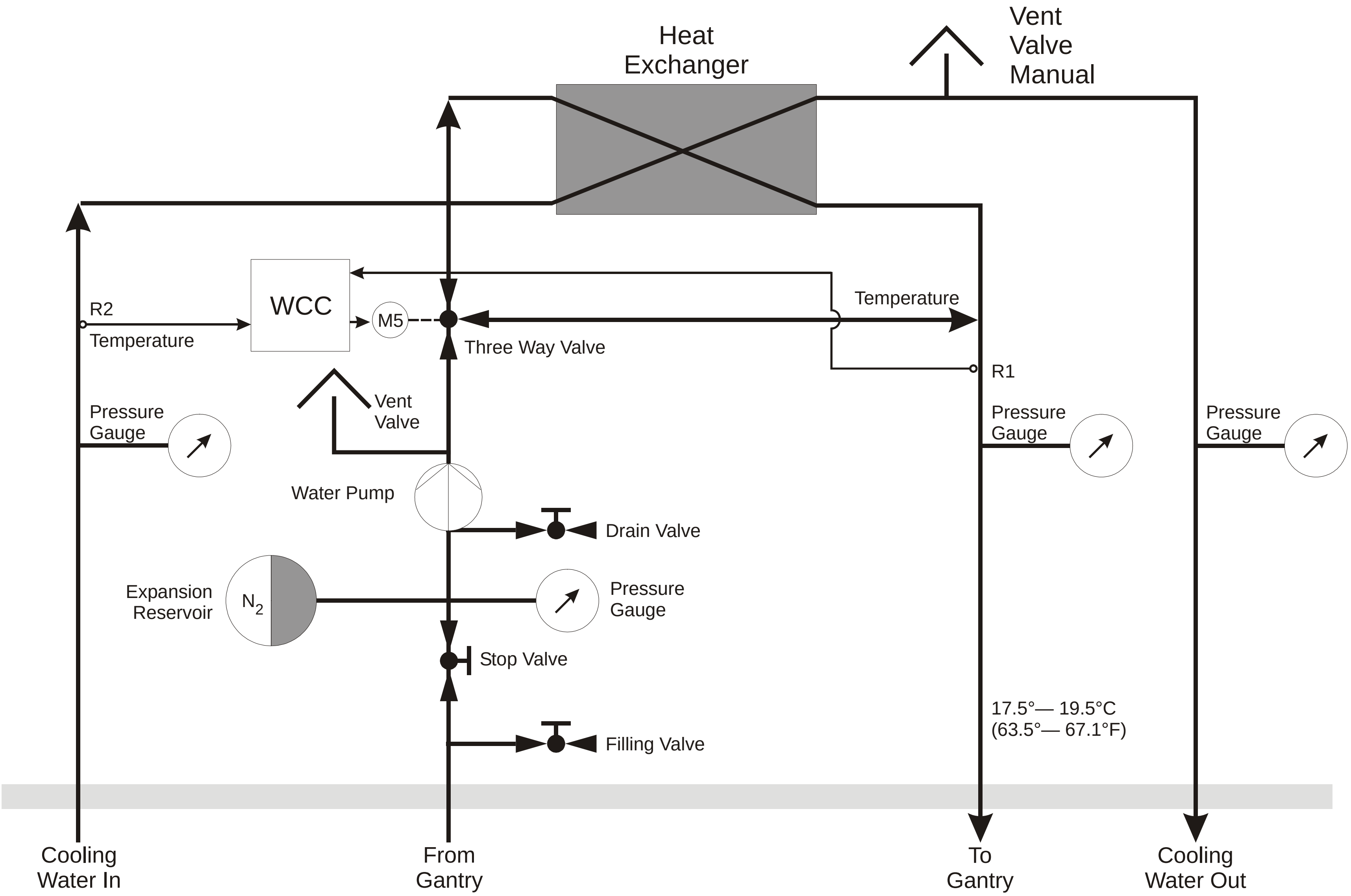

Heat Exchanger
Vent Valve Manual
WCC
M5
R2
Temperature
Temperature
Three Way Valve
R1
Vent Valve
Pressure Gauge
Pressure Gauge
Pressure Gauge
Water Pump
Drain Valve
Expansion Reservoir
N_2
Pressure Gauge
Stop Valve
Filling Valve
17.5°— 19.5°C
(63.5°— 67.1°F)
Cooling Water In
From Gantry
To Gantry
Cooling Water Out

Figure 7-3: Water-Water Cooling Unit Water Circuit

Water-Water Cooling Unit Electrical Circuit

Figure 7-4 shows the control and power circuit of the Water-Water Cooling Circuit. The temperature control and monitoring, and the powering on of the water pump is done from the Water Cooling Control (WCC). *Table 7-3* lists its components and describes their functions.

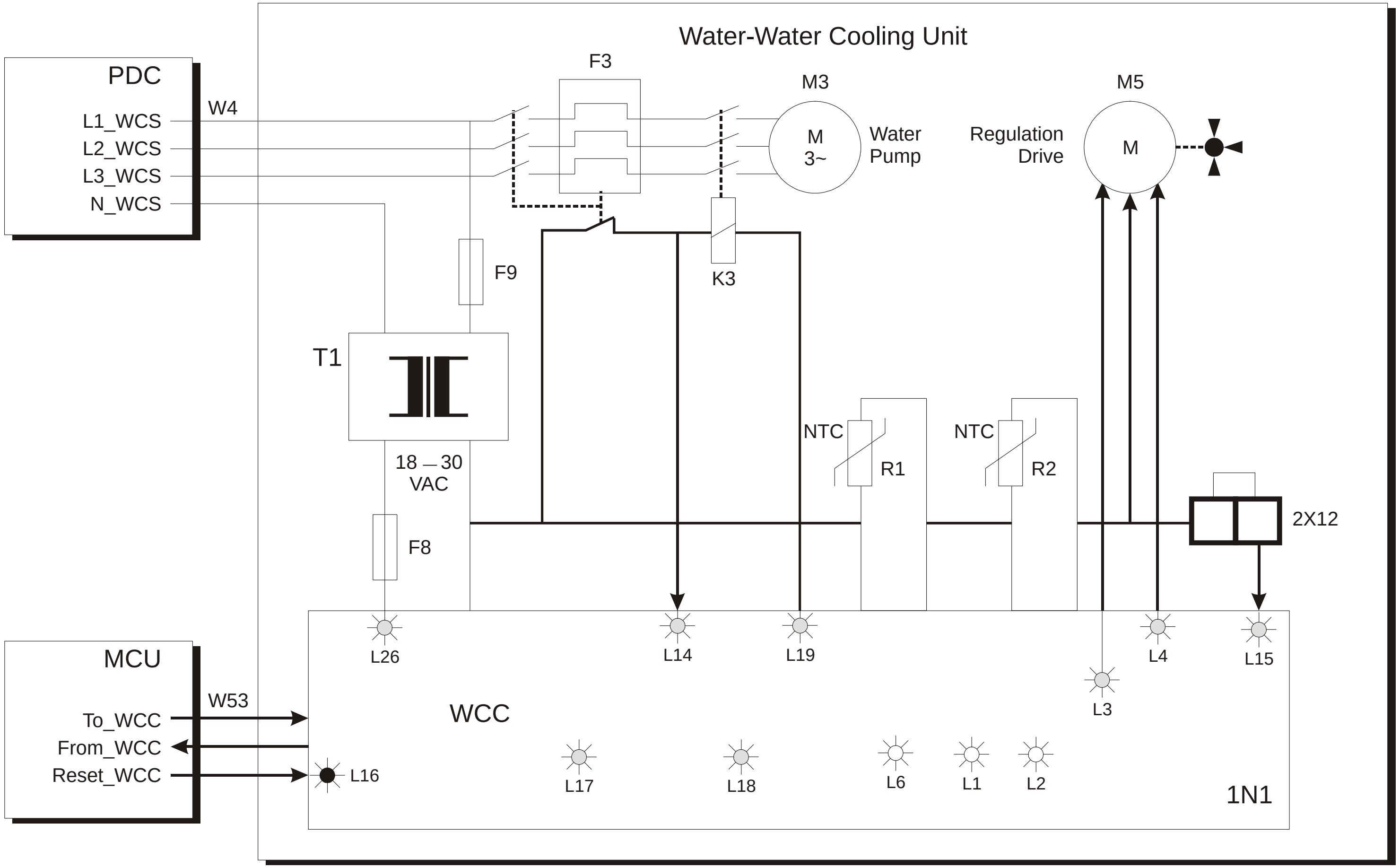

Water-Water Cooling Unit
PDC
L1_WCS
L2_WCS
L3_WCS
N_WCS
W4
F3
M3
M
3~
Water
Pump
M5
Regulation
Drive
M
F9
K3
T1
18 – 30
VAC
F8
NTC
R1
NTC
R2
2X12
MCU
To_WCC
From_WCC
Reset_WCC
W53
L26
L14
L19
L4
L15
L3
WCC
L16
L17
L18
L6
L1
L2
1N1

Figure 7-4: Water-Water Cooling Unit Electrical Circuit and LEDs

Table 7-3: Water-Water Cooling Unit Electrical Circuit Components

COMPONENT	DESCRIPTION
Water Cooling Control (WCC)	The regulation, monitoring and control circuits are located on a single processor board 1N1 (Type.17), also called Water Cooling Control (WCC). This board consists of: microprocessor, A/D converters for the temperature feedback and input/output drivers to control the relays and motors.
K3	K3 is the water pump contactor. K3 contactor connects the motor power controlled by the Water Cooling Control (WCC). In case of motor overcurrent, the F3 contact will cause K3 to drop out.
F3	F3 is the water pump overcurrent protection. In case of motor overcurrent, the F3 contact will cause K3 to drop out. The K3 contactor causes the motor power to disconnect.
R1	The temperature of the mixed water is measured by the Water Cooling Control (WCC) regulator via the probe (NTC) R1. This feedback is then used to regulate the water temperature through the position of the three-way valve.
R2	The temperature of the cooling water inlet is measured by the Water Cooling Control (WCC) via R2 probe (NTC). This value is monitored for service purposes.
Connector 2x12	It is possible to connect an external flow monitoring switch located in the hospital cold water circuit to connector 2X12. The flow of the cooling water is monitored by the Water Cooling Control (WCC) for service purposes. Insert a jumper if there is monitoring of the water flow.
Regulation Drive	The regulation drive of the three-way valve is controlled by the processor to change the valve position, i.e. to regulate the temperature of the cooling water (17.5°C-18.5°C, or 63.5°F to 65.3°F). The temperature of the mixed water is measured by the Water Cooling Control (WCC) regulator via the R1 probe (NTC).

Signals

L1_WCS, **L2_WCS**, **L3_WCS**

The Mains supply lines for the water cooling system.

The voltage is either 400 VAC/50 Hz or 460 VAC/60 Hz. Set the jumper in the PDC for either a 50 or 60 Hz supply, accordingly.

N_WCS The neutral supply line. Connect 230 VAC or 265 VAC to the transformer.

To_WCC The serial communication signal from the Master Control Unit (MCU) in the Gantry to the Water Cooling Control (WCC).

Parameters are: 1200 Baud, 1 start bit, 8 data bits, no parity, 1 stop bit.

From_WCC

The serial communication from the Water Cooling Control Unit (WCC) to the Master Control Unit (MCU) in the Gantry.

Parameters are: 1200 Baud, 1 start bit, 8 data bits, no parity, 1 stop bit.

Reset_WCC

A hardware line from the Master Control Unit (MCU), used to reset the water Cooling Control (WCC).

LEDs

L1	When lit, the firmware of the Water Cooling Control (WCC) is running.
L2	When lit, the service function of the WCC is active.
L3	When lit, the regulation drive should move towards warmer water (open bypass valve).
L4	When lit, the regulation drive should move towards colder water (close bypass valve).
L6	When lit, an error was detected in the water cooling system.
L14	When lit, the water pump F3 overcurrent protection responded.
L15	When lit, the external flowswitch is closed, or 2X12 is jumpered.
L16	When lit, **Reset_WCC** is active from the Master Control Unit (MCU).
L17	When lit, the output line is active.
L18	When lit, the output line is active.
L19	When lit, the output line, to switch the water pump ON, is active.
L26	When lit, WCC supply voltage is present, after the rectifier and the onboard fuse.

Water-Air Cooling Unit

This section describes Gantry cooling with the Water-Air cooling unit (*Figure 7-5*).

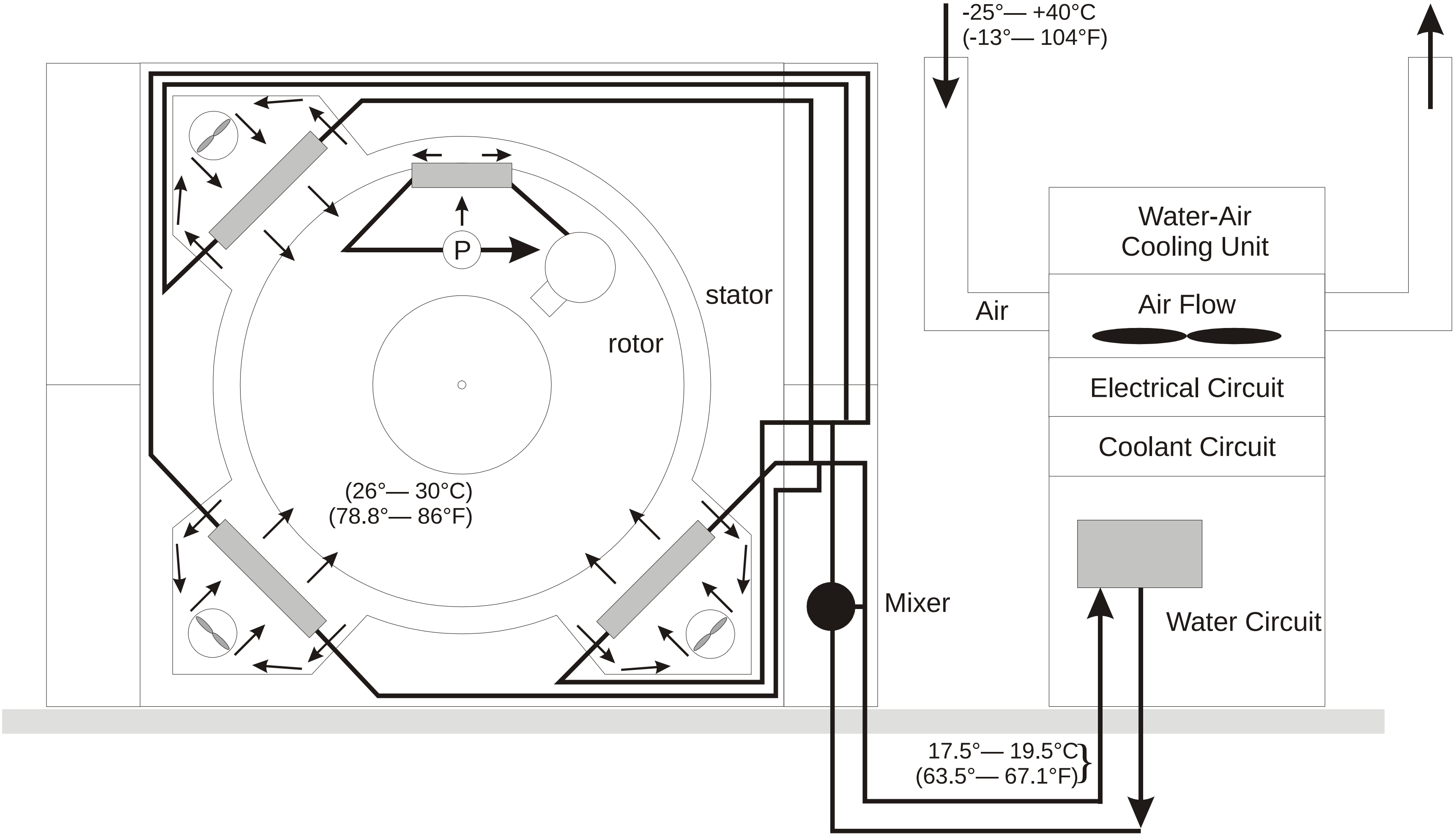

-25°— +40°C
(-13°— 104°F)
P
stator
rotor
(26°— 30°C)
(78.8°— 86°F)
Water-Air
Cooling Unit
Air
Air Flow
Electrical Circuit
Coolant Circuit
Mixer
Water Circuit
17.5°— 19.5°C
(63.5°— 67.1°F)

Figure 7-5: Water-Air Cooling Unit

Table 7-4 lists the Water-Air cooling unit components and describes their functions.

Table 7-4: Water-Air Cooling Unit Components

COMPONENT	FUNCTIONAL DESCRIPTION
Three Radial Fans	Three radial fans draw the air through an oil-air heat exchanger and a circular air duct between the stationary and rotating part of the Gantry. The fans then blow the air through three air-water heat exchangers back into the Gantry.
Gantry	The Gantry has a closed housing, and therefore, there is no air exchange between the inside and outside. The thermo-energy is picked up by heat exchangers inside the Gantry. There is an additional oil cooling circuit for the X-ray tube. The Gantry water circuit operates with a fixed cold water temperature of 17.5°C to 19.5°C (63.5°F to 67.1°F) and a flow of 3,000 1/h (792.516 gal/hr).
Mixer	A mixer valve inside the right Gantry stand keeps the air temperature between 26°C and 30°C (78.8°F and 86°F).
Water-Air Cooling Unit	The thermo energy is discharged by the air-water cooling unit to the ambient air. The temperature of the incoming air should be maintained between -25°C to +40°C (-13°F-+104°F). The nominal power of the cooling unit is 13.5 kW.

Water-Air Cooling Unit Water Circuit

This section describes the functions of the water circuit that is connected directly to the system cooling unit (*Figure 7-6* shows a block diagram). The heated water of the system Gantry flows through the vaporizer, is cooled to a temperature of 17.5°C to 19.5°C (63.5°F to 67.1°F) and then is returned to the Gantry. *Table 7-5* lists the components of the water circuit and describes their functions.

Table 7-5: Water-Air Cooling Unit Water Circuit Components

COMPONENT	DESCRIPTION
Pressure Gauge	The pressure gauge is used to check the water pressure of the water circuit. The initial set point is 2.2 bar (31.908 psi), if the cooling unit is switched off and there is no water flow.
Filling & Draining valve	The water valves are used to fill or discharge the water circuit. Filling of the water circuit must be done very slowly to prevent damage of the vent valve, heat exchanger and pipes of the water circuit. The initial filling procedure should take approximately 15 minutes.
Stop valve	The stop valve is used to close the water circuit during flushing of the cooling unit.
Expansion Reservoir	The expansion reservoir is used to prevent over-pressure in the water circuit due to temperature changes of the water. The volume of the vessel is divided, by a membrane, into a section filled with pressurized nitrogen, and a section filled with water.
Vent valve	The ventilation valve automatically discharges air within the water circuit.
R1	The outlet temperature of the water is measured by the Water Cooling Control (WCC) regulator via the R1 probe (NTC). This feedback is then used to regulate the water temperature through the cooling energy of the vaporizer.

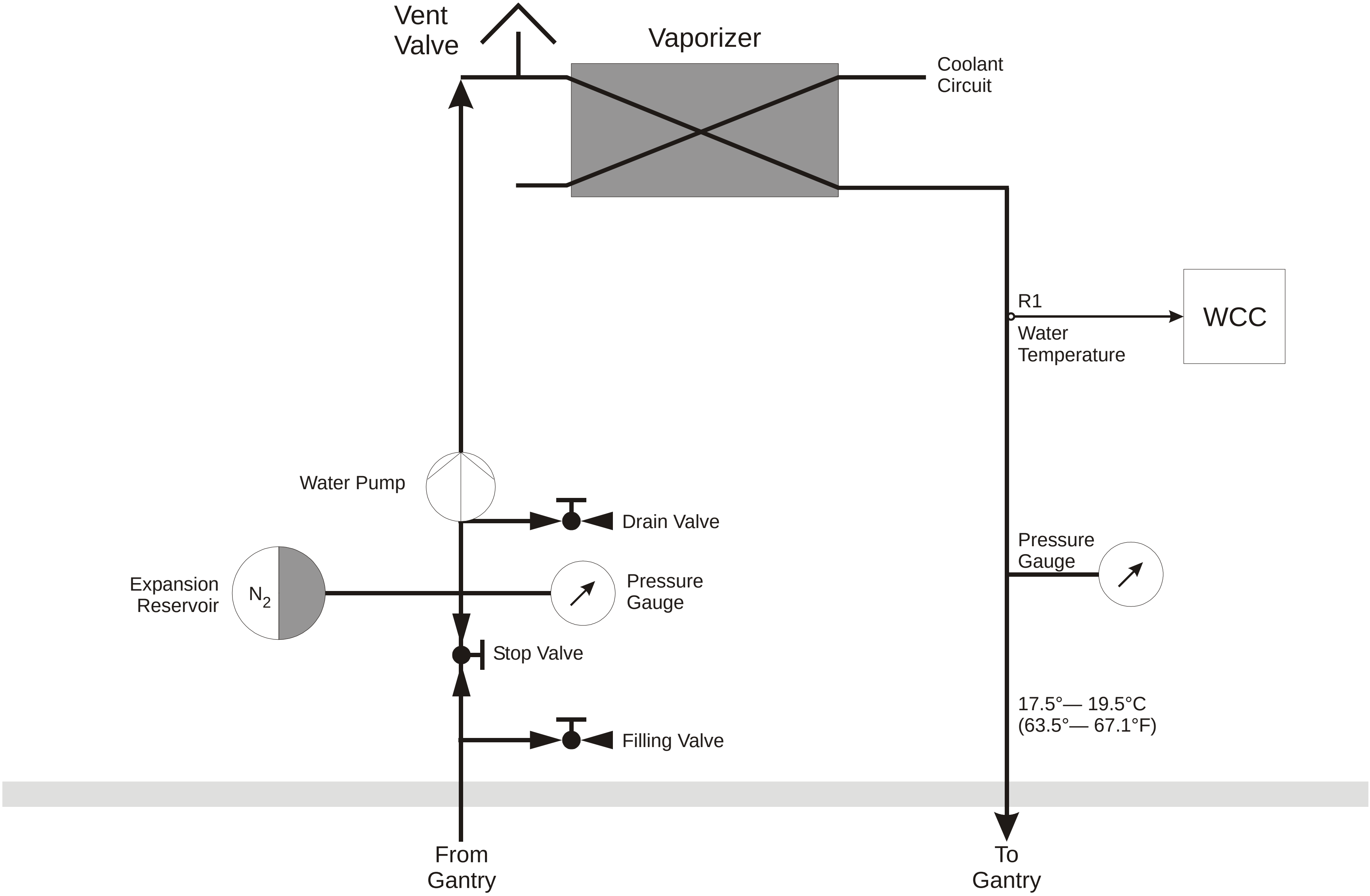

Vent
Valve
Vaporizer
Coolant
Circuit
R1
WCC
Water
Temperature
Water Pump
Drain Valve
Expansion
Reservoir
N_2
Pressure
Gauge
Pressure
Gauge
Stop Valve
17.5°— 19.5°C
(63.5°— 67.1°F)
Filling Valve
From
Gantry
To
Gantry

Figure 7-6: Water-Air Cooling Unit Water Circuit

Water-Air Cooling Unit Coolant Circuit

The coolant circuit transfers the excess heat from the water circuit to the air flow. Cooling is regulated by the a Thermostatic Expansion Valve (TEV) and a hot gas bypass regulator (see *Figure 7-7*).

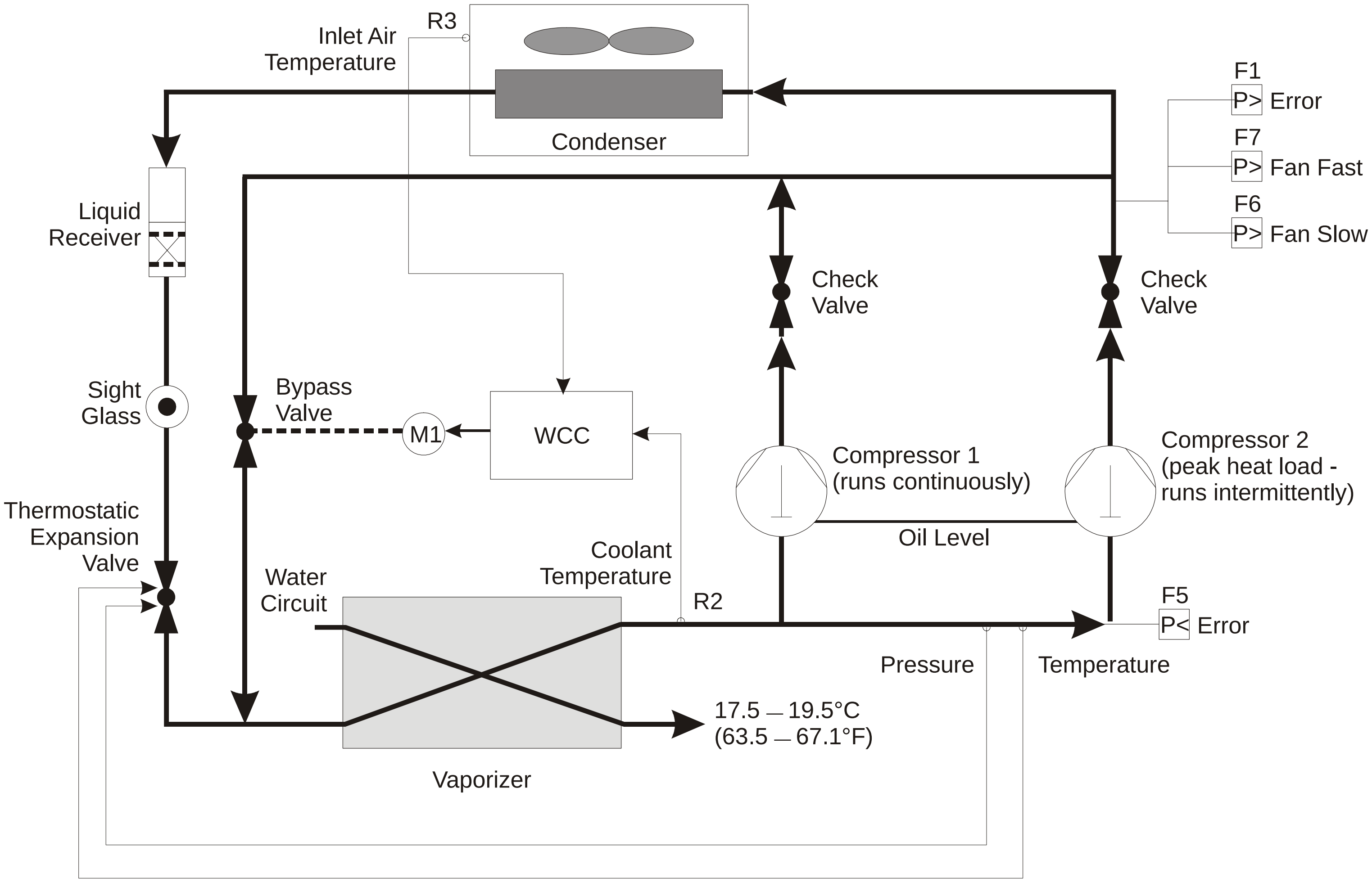

R3
Inlet Air
Temperature
Condenser
F1
P> Error
F7
P> Fan Fast
F6
P> Fan Slow
Liquid
Receiver
Check
Valve
Check
Valve
Sight
Glass
Bypass
Valve
M1
WCC
Compressor 1
(runs continuously)
Compressor 2
(peak heat load -
runs intermittently)
Oil Level
Thermostatic
Expansion
Valve
Water
Circuit
Coolant
Temperature
R2
F5
P< Error
Pressure
Temperature
17.5 – 19.5°C
(63.5 – 67.1°F)
Vaporizer

Figure 7-7: Water-Air Cooling Unit Coolant Circuit

Table 7-6 lists the components of the water-air cooling unit coolant circuit components and describes their functions.

Table 7-6: Water-Air Cooling Unit Coolant Circuit Components

COMPONENT	FUNCTIONAL DESCRIPTION
Liquid Receiver	The liquid receiver contains the liquid coolant that comes from the condenser.
Sight Glass	The liquid coolant is visible through this glass window.
Thermostatic Expansion Valve (TEV)	This is a temperature controlled overheating controller with a P-characteristic. The TEV must control the coolant supply to the vaporizer to ensure that the coolant is always gaseous, i.e., overheated at the outlet of the vaporizer. The external pressure feedback to the TEV allows a most exact regulation. The non-oscillating operation of the expansion valve with the vaporizer, as a closed-loop system, is a basic precondition for the entire system to operate steadily and to reach a constant high temperature.
Bypass Valve	The bypass valve connects the pressure side to the suction side. This valve allows hot gas to flow into the vaporizer.
WCC Regulation	The actual water temperature is measured and transmitted to the Water Cooling Control (WCC) regulator, via an R1 immersion sensor (NTC) inserted into the water circuit at the vaporizer outlet. The regulator compares the actual value to the set point of 18.5°C (65.3°F) and changes the position of the bypass valve via the regulating drive. Such a change allows more (or less) hot gas to flow into the vaporizer, thus adjusting the water temperature.
Water circuit	The water circuit is directly connected to the heat exchanger of the Gantry. The heated water coming from the Gantry is cooled down to 17.5°C to 19.5°C (63.5°F to 67.1°F) by the vaporizer block.
R2	The temperature of the coolant is measured at the suction side by the Water Cooling Control (WCC) via the R2 probe (NTC) (for freezing protection). This value is monitored for service purposes.

Table 7-6: Water-Air Cooling Unit Coolant Circuit Components (Cont)

COMPONENT	FUNCTIONAL DESCRIPTION
R3	The temperature of the air inlet is measured by the Water Cooling Control (WCC) via the R3 probe (NTC). This value is monitored for service purposes.
Condenser	The coolant medium, still under high pressure, is cooled down by the cold air flow in the condenser.
Vaporizer	The coolant medium evaporates in the vaporizer block. Behind the Thermostatic Expansion Valve (TEV), the coolant medium pressure is reduced which lowers the evaporation temperature of the coolant medium. Since the evaporating temperature is lower than the ambient temperature, the heating energy is packed up from the water circuit thus cooling down the water.
Compressor1	The evaporated coolant medium is compressed and heated up. Compressor 1 covers the basic heat load of 3.5 kW.
Compressor2	The evaporated coolant medium is compressed and heated up. Compressor 2 covers the peak heat load of 10 kW on top of the basic load.
Check Valve	The check valve prevents liquid coolant from flowing back to the compressor.
F1	F1 is the high pressure control protection of the coolant circuit. In the case of high pressure error, the contactors disconnect the motor power from the fan and both compressors.
F5	F5 is the low protection pressure control of the coolant circuit (against leakage). The compressors and the fan are switched off in the case of a low pressure error.
F6	F6 is the first stage high feedback pressure control from the coolant circuit. F6 will cause the Water Cooling Control (WCC) to switch the fan motor to star connection (slow speed).
F7	F7 is the second stage high feedback pressure control from the coolant circuit. F7 will cause the Water Cooling Control (WCC) to switch the fan motor to delta connection (fast speed).
Insulation	All cold parts are insulated to prevent the generation of condensed water.

Water-Air Cooling Unit Air Flow

Cool air is drawn in with a radial fan. It is then used for cooling and blown back to the environment. See *Figure 7-8* for a block diagram.

The temperature of the incoming air should be -25°C to +40°C (-13°F-+104°F).

Table 7-7 lists the components of the water-air cooling unit air flow components and describes their functions.

Table 7-7: Water-Air Cooling Unit Air Flow Components

COMPONENT	DESCRIPTION
Wall Adapter	The air louvers (which nearly completely prevent air circulation when standing still) are located in the inlet/outlet wall adapter.
Air filter	An air filter (wire screen) built into the inlet wall adapter filters the incoming air.
Air Hose	Cold air reaches the air duct via the insulated air hose and the adapter at the cooling unit. Warm air is blown back to the outlet-wall adapter via the insulated air hose. The maximum length of the air hoses is 4m (13.123 feet). The air hoses are insulated to prevent the generation of condensed water. Make the air hose as short and straight as possible.
Alternative Air Hose Connection	The air hoses may be connected both to the right side, or to the left side, or one hose to each side of the system.
Radial fan	The air flow reaches the condenser after the air duct. A radial fan draws the air through the condenser and into the exhaust hose. The fan operates at one of two speeds, depending on the heat load.

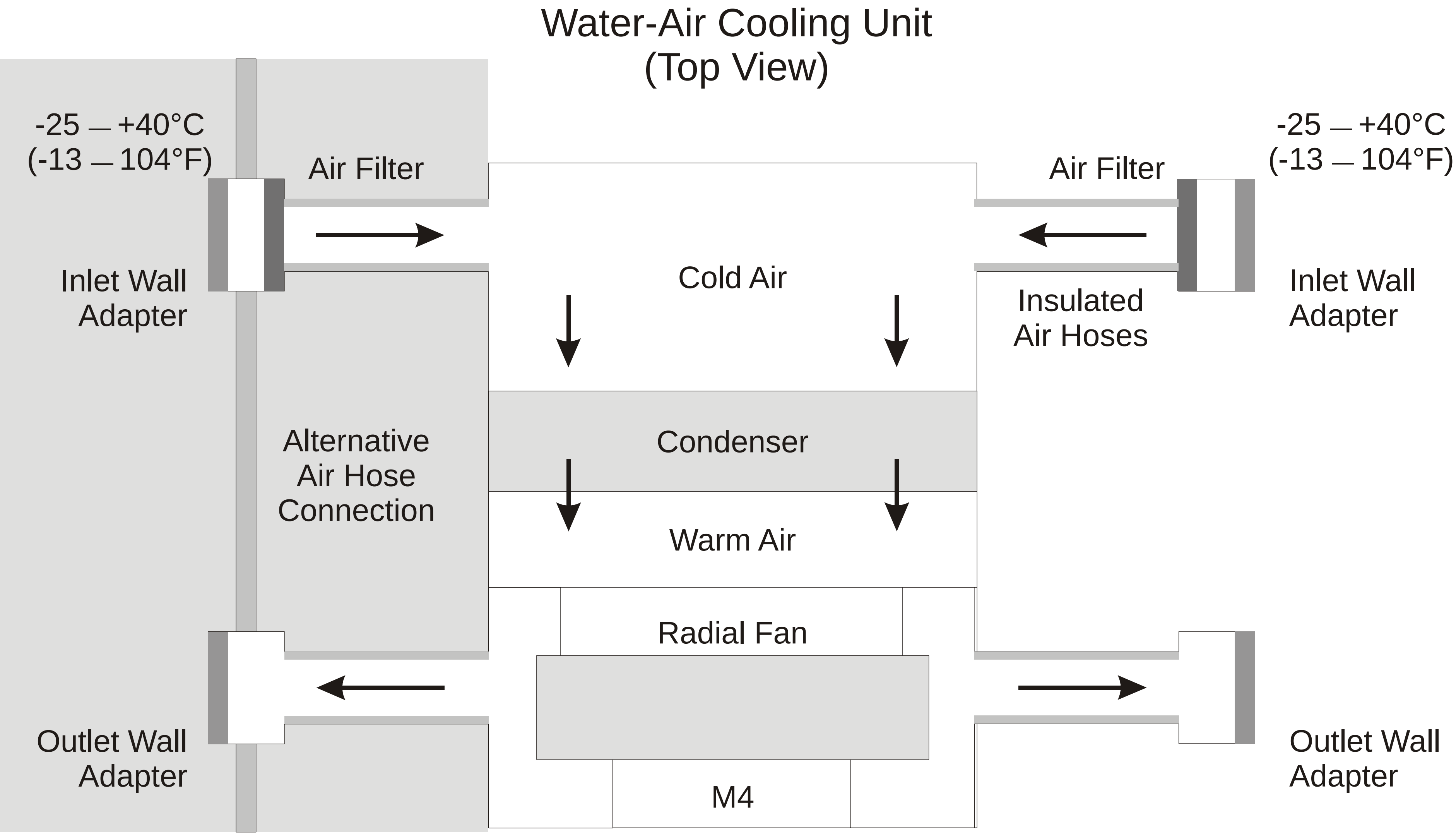

Water-Air Cooling Unit
(Top View)
-25 — +40°C
(-13 — 104°F)
Air Filter
Inlet Wall Adapter
Alternative Air Hose Connection
Outlet Wall Adapter
Cold Air
Condenser
Warm Air
Radial Fan
M4
Air Filter
-25 — +40°C
(-13 — 104°F)
Insulated Air Hoses
Inlet Wall Adapter
Outlet Wall Adapter

Figure 7-8: Water-Air Cooling Unit Air Flow

Water-Air Cooling Unit Electrical Circuit 1

The Water Cooling Control (WCC) unit does the following:

- Controls and monitors the temperature
- Monitors and switches ON the water pump, fan and compressors

Figure 7-9 shows the electrical control circuit of the water-air cooling unit.

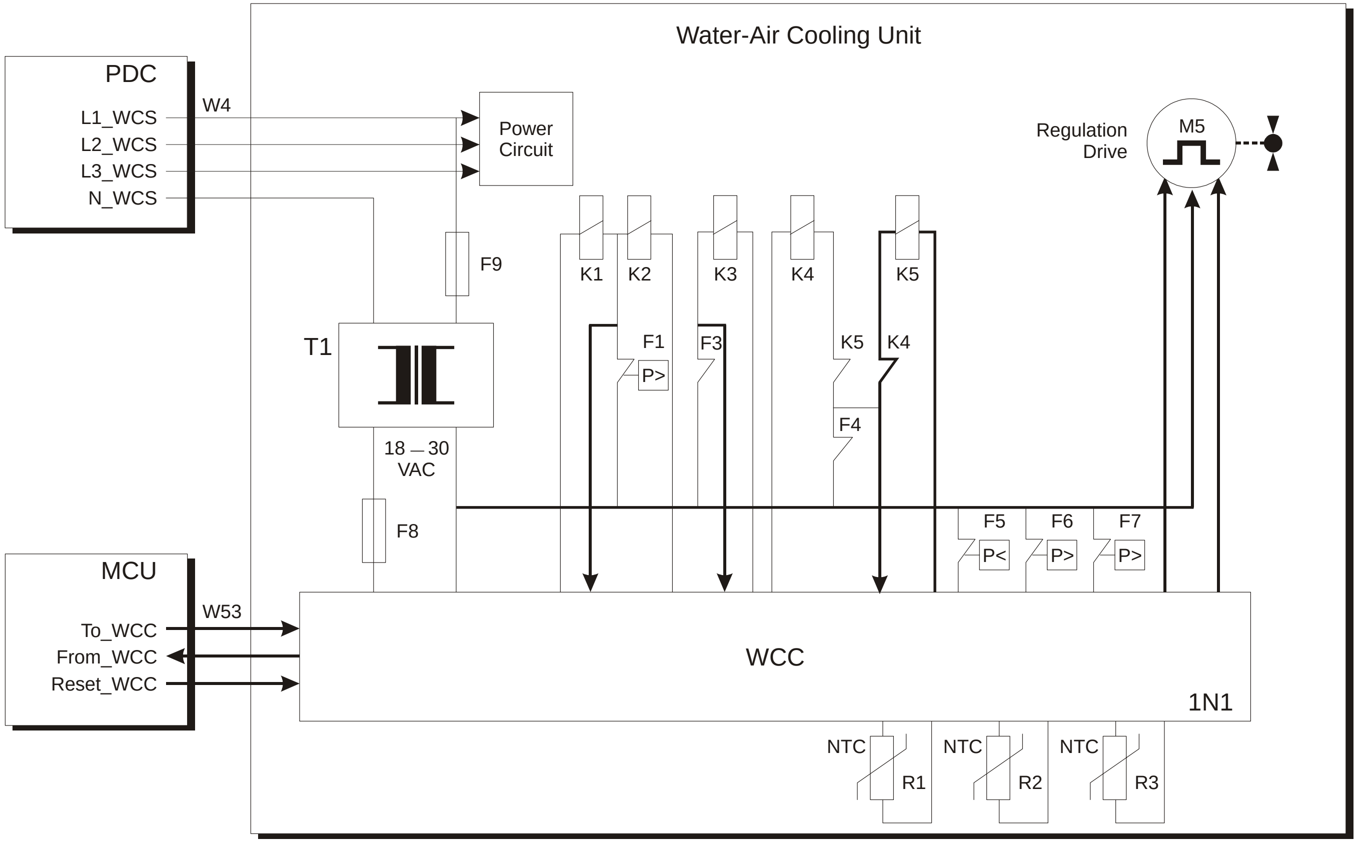

Water-Air Cooling Unit
PDC
L1_WCS
L2_WCS
L3_WCS
N_WCS
W4
Power Circuit
Regulation Drive
M5
F9
K1
K2
K3
K4
K5
T1
F1
P>
F3
K5
K4
F4
18 – 30 VAC
F8
F5
F6
F7
P<
P>
P>
MCU
To_WCC
From_WCC
Reset_WCC
W53
WCC
1N1
NTC
R1
NTC
R2
NTC
R3

Figure 7-9: Water-Air Cooling Unit Electrical Circuit

Table 7-8: Water-Air Cooling Unit Electrical Circuit Components and Functions

COMPONENT	FUNCTIONAL DESCRIPTION
WCC	The regulation, monitoring and control circuits are located on a single processor board 1N1 (Type.010), also called Water Cooling Control (WCC). This board consists of a microprocessor and A/D converters (for the temperature feedback and input/output drivers to control the relays and motors).
K1	The K1 fan and compressor 1 contactor connects the motor power controlled by the Water Cooling Control (WCC). The F1 contact causes K1 to disconnect if pressure rises in the coolant circuit.
K2	The K2 compressor 2 contactor. connects the motor power controlled by the Water Cooling Control (WCC). The F1 contact causes K2 to disconnect if pressure rises in the coolant circuit.
F1	F1 controls high pressure to protect the coolant circuit. The F1 contact causes K1 and K2 to disconnect in case of high pressure error. The contactors disconnect the motor power from the fan and both compressors.
K3	The K3 water pump contactor connects the motor power controlled by the Water Cooling Control (WCC). TheF3 contact causes K3 to disconnect in case of motor overcurrent.
F3	F3 protects the water pump from overcurrent. It first causes K3 to disconnect in case of motor overcurrent and then causes the motor power to disconnect from the pump.
K4	K4 is the fan star connection contactor (slow speed). The K4 contactor connects the star point to the motor controlled by the Water Cooling Control (WCC). The F4 contact causes K4 to disconnect in case of motor overcurrent. K5 contact interlocks K4.
K5	K5 is the fan delta connection contact (fast speed). The K5 contactor connects the motor in delta controlled by the Water Cooling Control (WCC). The function of the F4 contact is to cause K5 to disconnect in case of motor overcurrent. K4 contact interlocks K5.

Table 7-8: Water-Air Cooling Unit Electrical Circuit Components and Functions (Cont)

COMPONENT	FUNCTIONAL DESCRIPTION
F4	F4 provides overcurrent protection for the integrated fan motor. It causes K4 and K5 to disconnect in case of motor overcurrent. Both contactors then cause the motor power to disconnect from the fan.
F5	F5 is the pressure control low protection of the coolant circuit (against leakage). The compressors and the fan switch OFF in case of low pressure error.
F6	F6 is the first stage pressure control high feedback from the coolant circuit. It causes the Water Cooling Control (WCC) to switch the fan motor to star connection (slow speed).
F7	F7 is the second stage pressure control high feedback from the coolant circuit. It causes the Water Cooling Control (WCC) to switch the fan motor to delta connection (fast speed).
R1	The temperature of the mixed water is measured by the Water Cooling Control (WCC) regulator via the R1 probe (NTC). This feedback is then used to regulate the water temperature through the position of the bypass valve.
R2	The temperature of the coolant is measured at the suction side by the Water Cooling Control (WCC) via the probe (NTC) R2 (protection against freezing). This value is monitored for service purposes.
R3	The temperature of the air inlet is measured by the Water Cooling Control (WCC) via the R3 probe (NTC). This value is monitored for service purposes.
Regulation Drive	The Regulation Drive of the bypass valve is controlled by the processor to change the valve position, i.e., to regulate the temperature of the cooling water (17.5°C to 18.5°C, or 63.5°F to 65.3°F). The temperature of the outlet water is measured by the Water Cooling Control (WCC) regulator via R1 probe (NTC).

Signals

L1_WCS L2_WCS L3_WCS These signals are Mains supply lines for the water cooling system.

The voltage is either 400 VAC/50 Hz or 460 VAC/60 Hz. Change the jumper in the PDC to a 50 or a 60 Hz supply, accordingly.

N_WCS The neutral supply line. This signal connects 230 VAC or 265 VAC to the transformer.

To_WCC The serial communication signal from the Master Control Unit (MCU) in the Gantry to the Water Cooling Control (WCC).

The parameters are: 1200 Baud, 1 start bit, 8 data bits, no parity, 1 stop bit.

From_WCC
The serial communication signal from the Water Cooling Control Unit (WCC) to the Master Control Unit (MCU) in the Gantry.

The parameters are: 1200 Baud, 1 start bit, 8 data bits, no parity, 1 stop bit.

Reset_WCC
A hardware line from the Master Control Unit (MCU) used to reset the water Cooling Control (WCC).

LEDs

L1	The firmware of the Water Cooling Control (WCC) is running.
L2	The service function of the WCC is active.
L3	The regulation drive should move in the direction of warmer water (open bypass valve).
L4	The regulation drive should move in the direction of colder water (close bypass valve).
L6	An error was detected in the Water Cooling System.
L8	The second stage high pressure control feedback from the coolant circuit is detected with F7.
L9	The first stage high pressure control feedback from the coolant circuit is detected with F6.
L10	The high pressure control protection of the coolant circuit is detected with F1.
L11	The low pressure control protection of the coolant circuit is detected with F5.
L14	The F3 water pump overcurrent protection responded.
L15	The F4 integrated fan motor overcurrent protection responded.
L16	Reset_WCC is active from the Master Control Unit (MCU).
L17	The output line to switch compressor 1 ON, is active.
L18	The output line to switch compressor 2 ON, is active.
L19	The output line to switch the water pump ON, is active.
L21	The output line to switch the fan to star connection, is active.
L22	The output line to switch the fan to delta connection, is active.
L26	WCC supply voltage is present, following the rectifier and the onboard fuse.

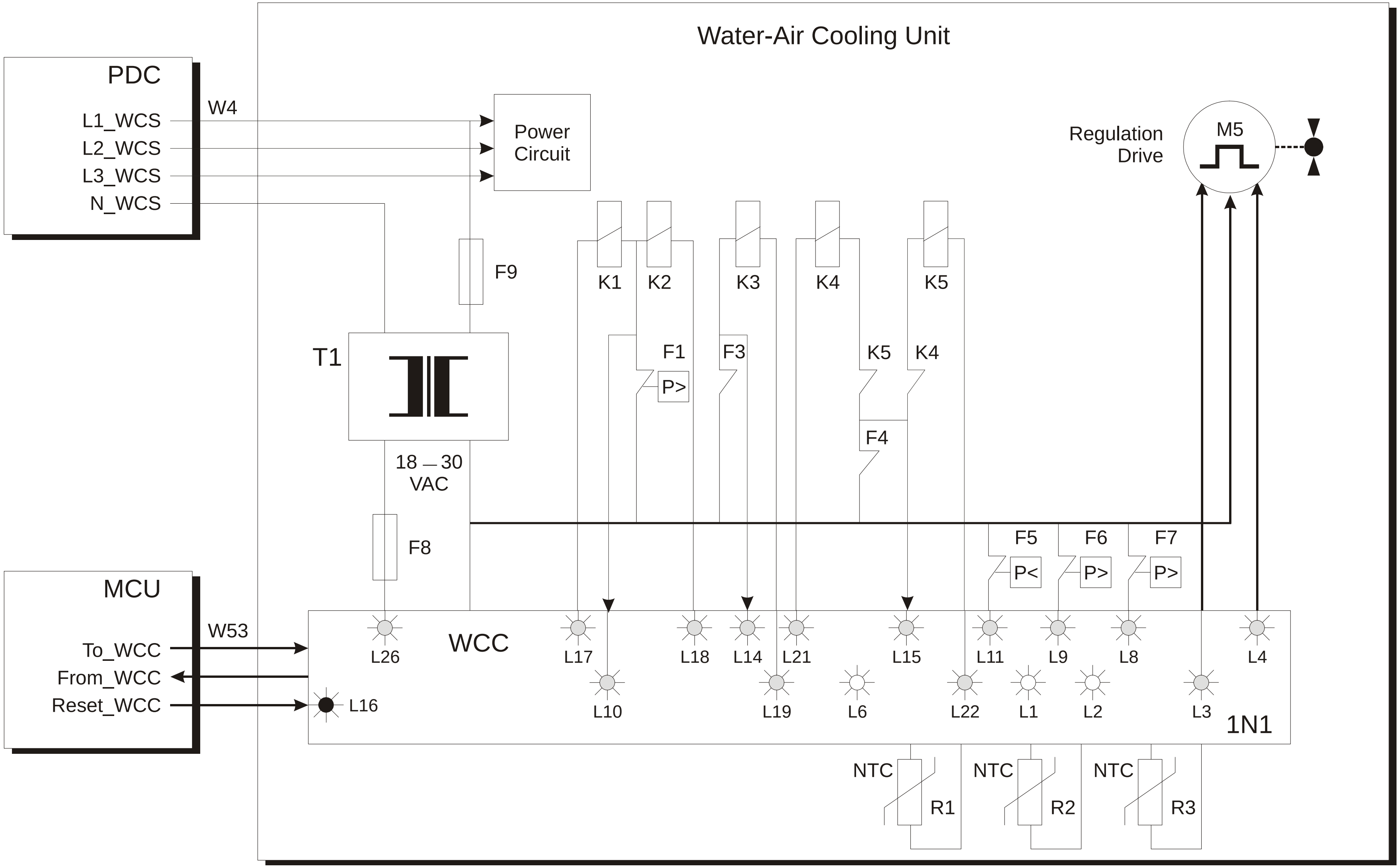

Water-Air Cooling Unit
PDC
L1_WCS
L2_WCS
L3_WCS
N_WCS
W4
Power Circuit
Regulation Drive
M5
F9
K1
K2
K3
K4
K5
T1
F1
P>
F3
K5
K4
F4
18 — 30 VAC
F8
F5
F6
F7
P<
P>
P>
MCU
W53
To_WCC
From_WCC
Reset_WCC
WCC
L26
L17
L18
L14
L21
L15
L11
L9
L8
L4
L16
L10
L19
L6
L22
L1
L2
L3
1N1
NTC
R1
NTC
R2
NTC
R3

Figure 7-10: Water-Air Cooling Unit LEDs

Water-Air Cooling Unit Electrical Circuit 2

Figure 7-11 shows the electrical power circuit of the water-air cooling unit. *Table 7-9* lists its components and describes their functions. The operation of the water pump, fans and compressors is controlled by the Water Cooling Control (WCC).

Table 7-9: Water-Air Cooling Unit Electrical Circuit 2 Components

COMPONENT	FUNCTIONAL DESCRIPTION
E1	E1 is the oil heater of compressor 2. E1 becomes active if compressor 2 is switched off from the K2 contactor.
K1	K1 is the fan and compressor 1 contactor. The K1 contactor connects the motor power controlled by the Water Cooling Control (WCC). The function of the F1 contact is to cause K1 to disconnect if pressure control is high in the coolant circuit.
K2	K2 is the compressor 2 contactor. The K2 contactor connects the motor power controlled by the Water Cooling Control (WCC). The function of F1 contact is to cause K2 to disconnect if pressure control is high in the coolant circuit.
K3	K3 is the water pump contactor. The K3 contactor connects the motor power controlled by the Water Cooling Control (WCC). The function of F3 contact is to cause K3 to disconnect in case of motor overcurrent.
F3	F3 is the water pump overcurrent protection. The function of F3 contact is to cause K3 to disconnect in case of motor overcurrent. Then the K3 contactor causes the motor power to disconnect from the pump.
K4	K4 is the fan star connection contact (slow speed). The K4 contactor connects the star point to the motor controlled by the Water Cooling Control (WCC). The function of F4 contact is to cause K4 to disconnect in case of motor overcurrent. K5 contact interlocks with K4.
K5	K5 is the fan delta connection contact (fast speed). The K5 contactor connects the motor in delta controlled by the Water Cooling Control (WCC). The function of F4 contact is to cause K5 to disconnect in case of motor overcurrent. K4 contact interlocks with K5.
F4	F4 is the integrated fan motor overcurrent protection.. In the case of motor overcurrent, the function of F4 contact is to cause K4 and K5 to disconnect. Then both contactors cause the motor power to disconnect from the fan.

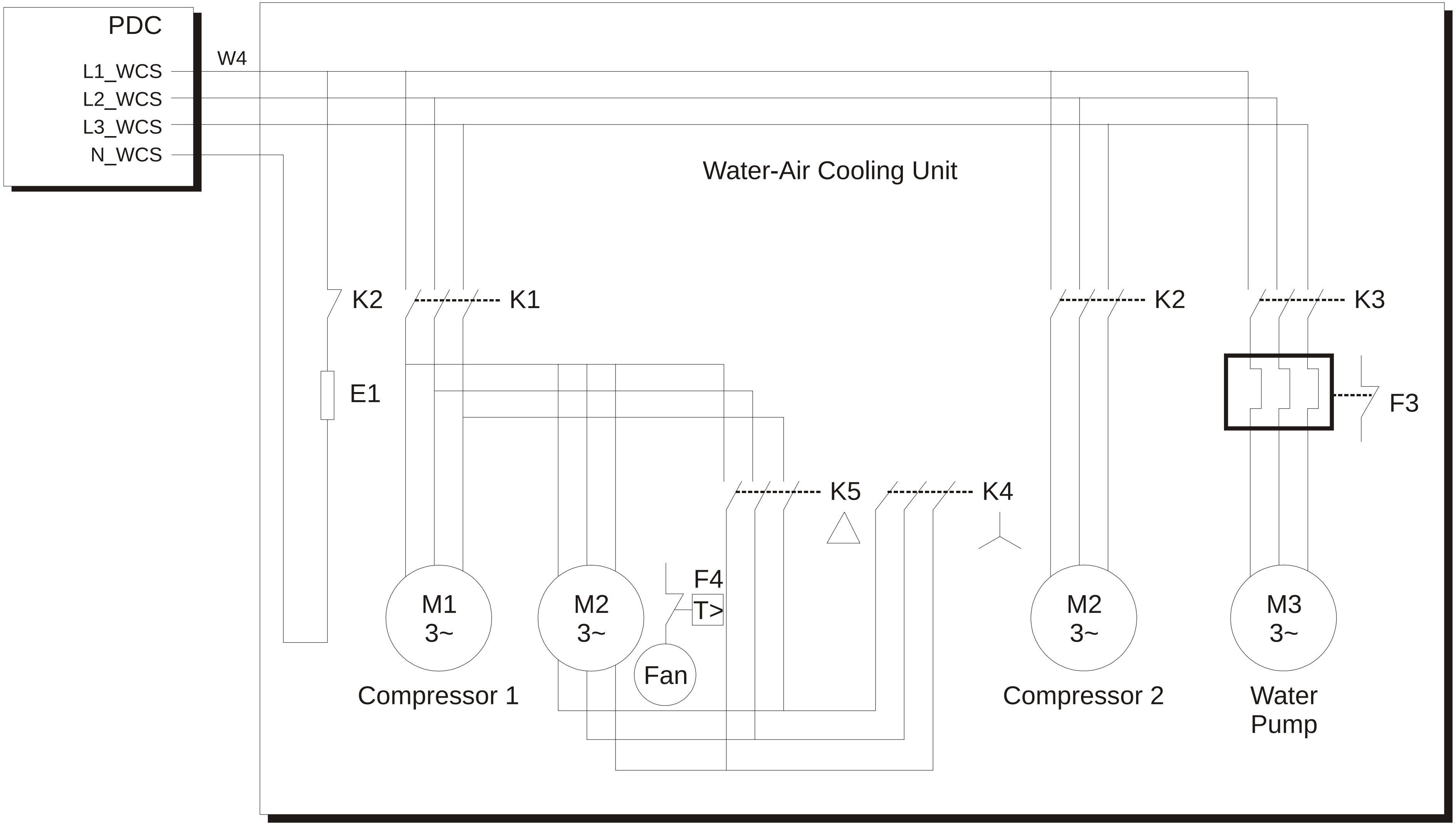

PDC
L1_WCS
L2_WCS
L3_WCS
N_WCS
W4
Water-Air Cooling Unit
K2
K1
K2
K3
E1
F3
K5
K4
F4
T>
M1
3~
M2
3~
Fan
M2
3~
M3
3~
Compressor 1
Compressor 2
Water
Pump

Figure 7-11: Water-Air Cooling Unit/Electrical Power Circuit

Parts Replacement

This section describes parts replacement procedures for both Water-Water and Water-Air cooling systems. System-specific procedures are noted accordingly.

The following instructions contain important safety information as well as information about tools to be used.

⚠ **CAUTION**

FILLING AS WELL AS REFILLING OF THE GANTRY WATER CIRCUIT MUST BE PERFORMED WITH THE WCS SWITCHED OFF! IT IS PROHIBITED TO OPERATE THE WATER PUMP OF THE WCS SYSTEM BEFORE THE GANTRY WATER CIRCUIT (GANTRY WCS LOOP) HAS BEEN (RE)FILLED! EVEN SHORT-TERM OPERATION WITHOUT WATER WILL DESTROY THE WATER PUMP.

DO NOT OPERATE THE SYSTEM IN CUSTOMER MODE AT THE INCREASED WATER PRESSURE USED FOR THE TEST. ALWAYS RETURN THE WATER PRESSURE TO THE NOMINAL OPERATING PRESSURE OF 2.0 BAR±0.2 BAR, WITH THE HEAT EXCHANGER SWITCHED OFF.

⚠ **CAUTION**

WHEN OPENING OR TIGHTENING COPPER PIPE CONNECTIONS, HOLD THE PIPE WITH A PIPE WRENCH. OTHERWISE, THE COPPER PIPE COULD BEND, CAUSING LEAKS.

ALL GASKETS REQUIRED IN THE WATER CIRCULATION SYSTEM ARE INCLUDED WITH THE SPARE PARTS. ALWAYS USE NEW GASKETS WHEN REPLACING THESE PARTS.

Tools

- Standard FSE tool kit
- 27 mm, 30 mm, 46 mm and 52 mm wrenches or crescent wrench
- Pipe wrench
- 2 water hoses with 1/2’’ connections for filling and draining the system
- Manometer (included with the delivery of WCS)
- Absorbent cloth
- Cable ties
- Heat-conducting paste (HEAT SINK GREASE / item number 20 48 650)
- Aluminum foil tape

Water-Water Cooling System Overview

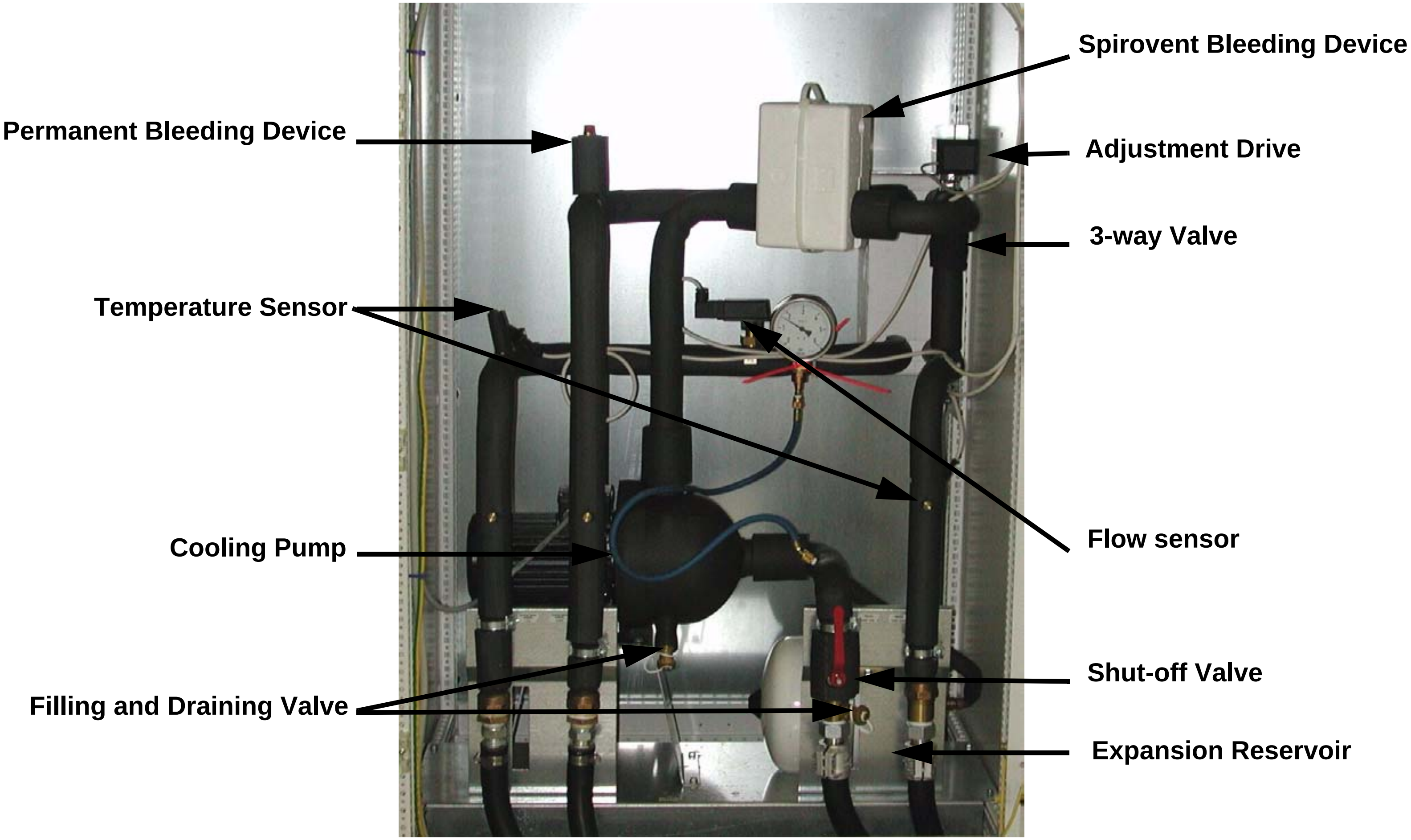

Spirovent Bleeding Device
Permanent Bleeding Device
Adjustment Drive
3-way Valve
Temperature Sensor
Cooling Pump
Flow sensor
Shut-off Valve
Filling and Draining Valve
Expansion Reservoir

Figure 7-12: Water-Water Cooling System

Water-Air Cooling System Overview

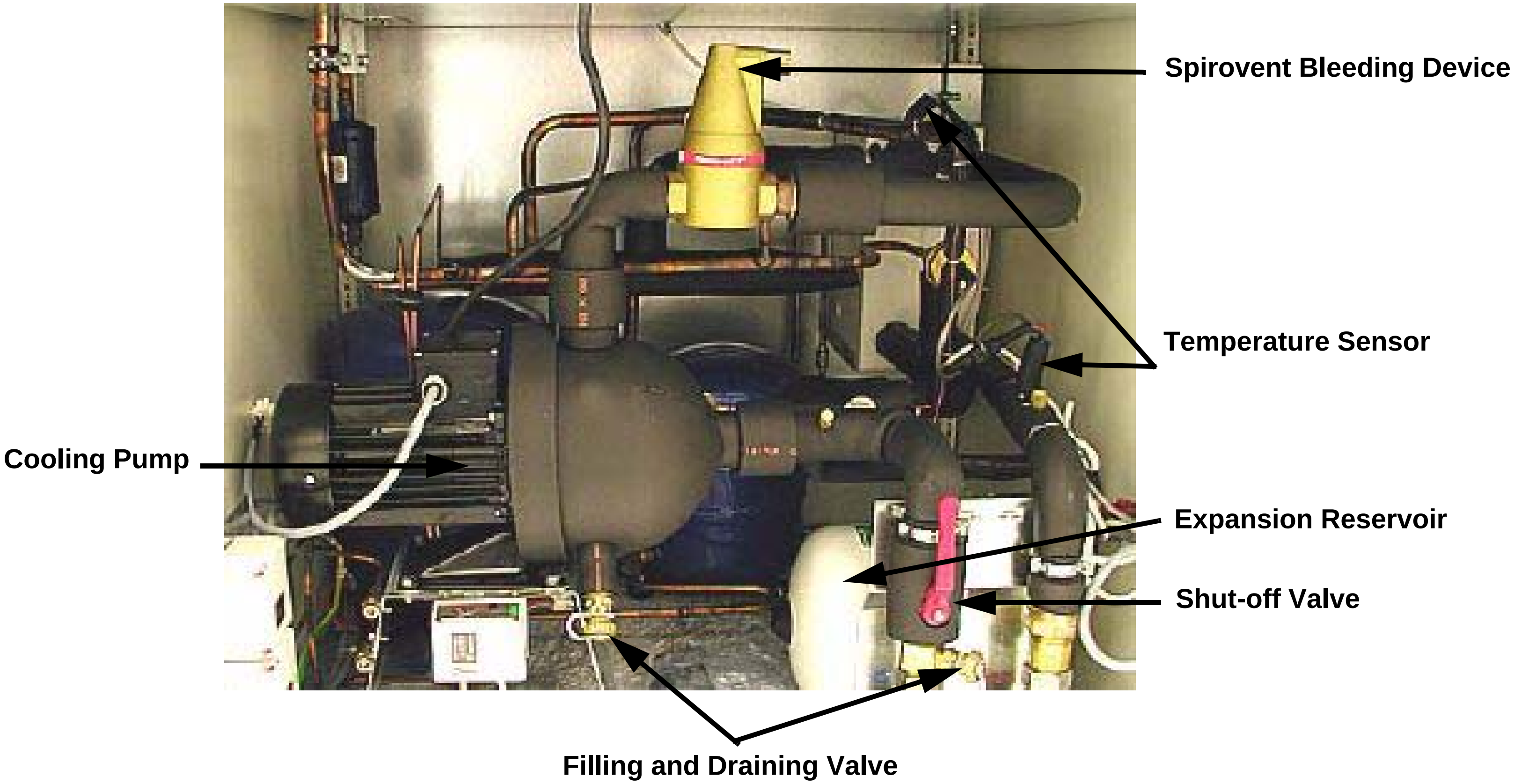

Spirovent Bleeding Device
Temperature Sensor
Cooling Pump
Expansion Reservoir
Shut-off Valve
Filling and Draining Valve

Figure 7-13: Water-Air Cooling System

Draining and Filling the Cooling System

Draining the Cooling System

When is it necessary to drain the Gantry cooling system?

REPLACEABLE PARTS	**IS IT NECESSARY TO DRAIN THE GANTRY COOLING SYSTEM FIRST?**	
	WATER-WATER (see *Figure 7-12*))	**WATER-AIR** (see *Figure 7-13*))
Permanent bleeding device	no	N/A
Temperature sensor	no	no
Adjustment drive for 3-way valve	no	no
Cooling pump	yes	yes
Spirovent bleeding device	yes	yes
3-way valve	yes	N/A
Expansion reservoir	yes	yes
Flow sensor	yes (Primary cooling circuit)	N/A
Filling and draining valve	yes	yes
Shut-off valve	yes	yes

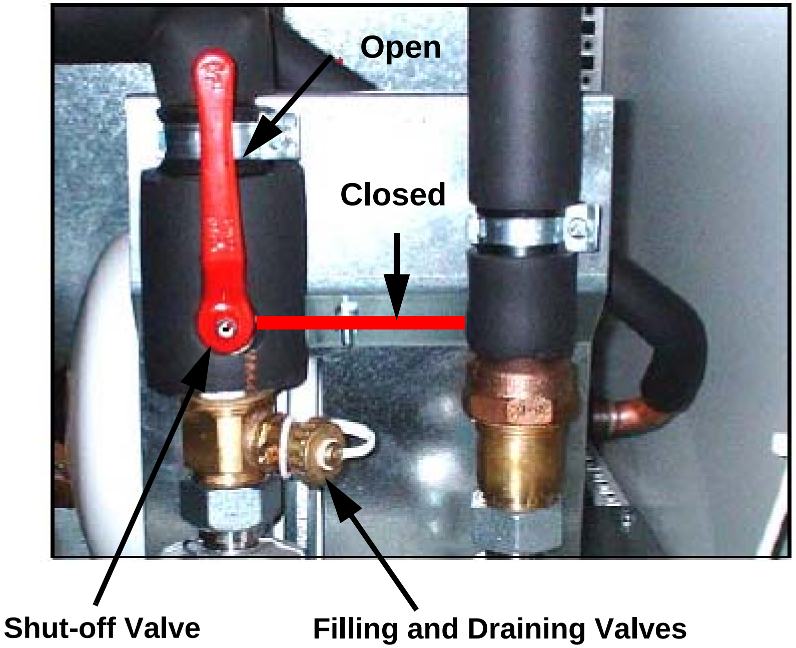


Figure 7-14:

Draining Process

WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

1. Switch off the WCS system via breaker F14 in the PDC system.
2. Connect the water hoses to the filling and draining valves (see *Figure 7-14*).
3. Place absorbent cloth under the filling and draining valves (see *Figure 7-14*), because water may escape when the connection is opened.
4. Route the water hoses to a syphon or a bucket.
5. The end of the hose must be lower than the filling and draining valves, otherwise the water will not fully drain from the cooling system.
6. Open the filling and draining valves by turning them 90° counter clockwise using the valve cap.
7. The valve is open when the notch on the valve is lined up with the connection pipe (see *Figure 7-14*).
8. The red shut-off valve for the gantry cooling system must be open.
9. The lever is in line with the connection pipe (see *Figure 7-14*).
10. The cooling system is empty when water no longer flows from the water hoses.

Additional Procedures

Additional work is necessary for replacement of Gantry heat exchanger or water hoses or if the Gantry must be de-installed.

1. Close the red shut-off valve (see *Figure 7-14*).
2. Connect compressed air (approx. 3.5 bar) to the filling valve (see *Figure 7-14*).
3. Close the 3-way valve in the right stand of the gantry (see *Figure 7-15*) with an Allen key. The white screw (see *Figure 7-16*) must be in CCW end position (mechanical stop).

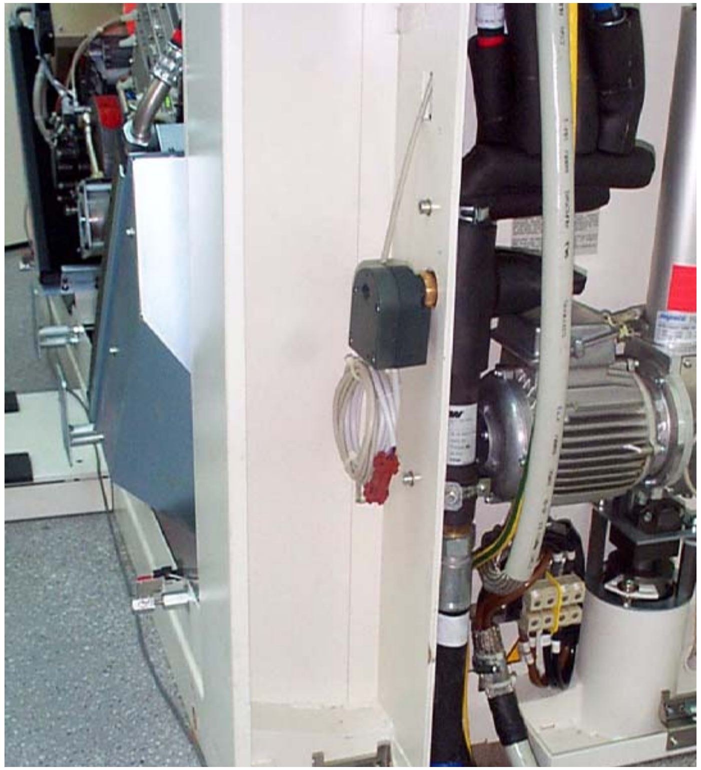


Figure 7-15: 3-way Valve

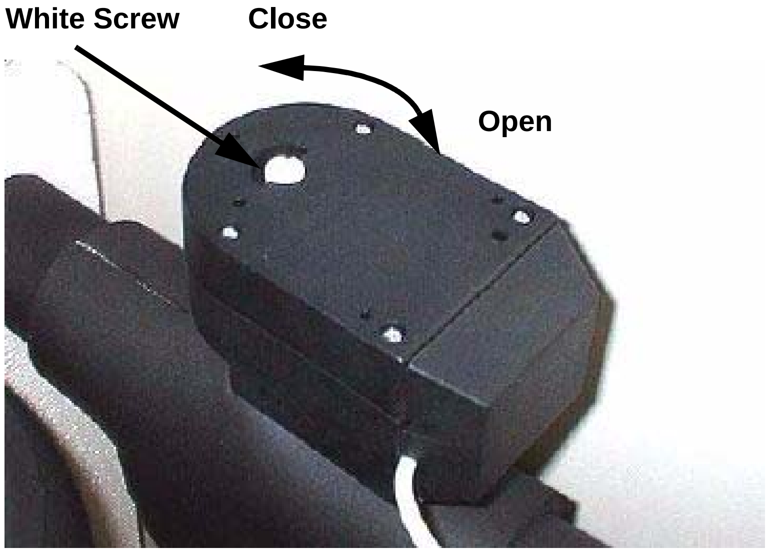


Figure 7-16: 3-way Valve—Detail

4. Open the 3-way valve one revolution CW.
5. Supply compressed air two minutes.
6. Open the 3-way valve CW until the mechanical stop.
7. Evacuate the water, until the cooling system is empty (approx. 20 minutes).
   The water volume of the complete cooling system can be calculated by adding:
   - the water volume from the water/water cooling cabin (approx. 9-10 liter) and
   - the water volume from the water pipes (approx. 0.5 liter per meter)

NOTE:

The water volume of the complete cooling system is approx. 30liters (if 20 m water pipes to and from Gantry is used).

Filling the Water Cooling System

⚠ CAUTION

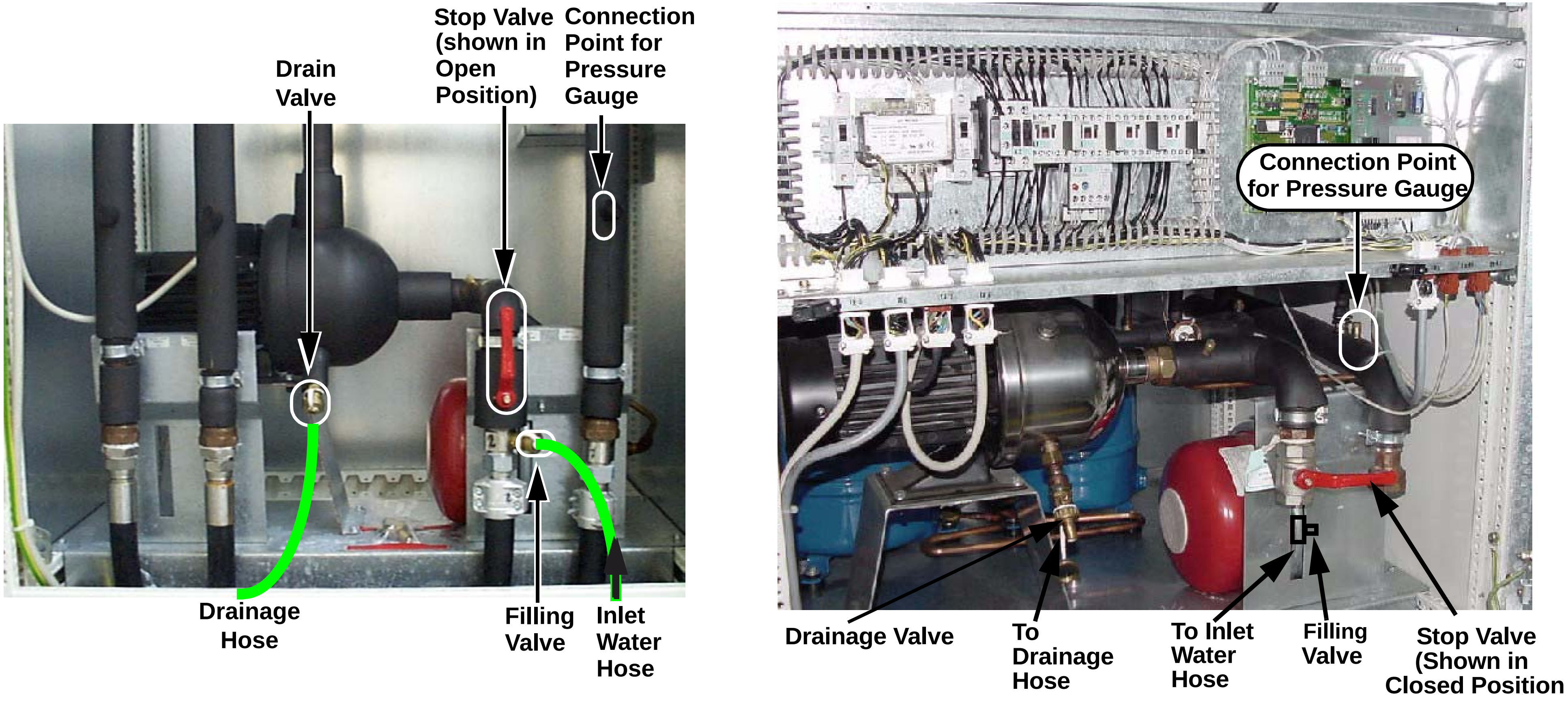
- THE WCS MUST BE SWITCHED OFF WHENEVER YOU FILL OR DRAIN THE GANTRY WATER SYSTEM.
- DO NOT TURN ON THE WATER PUMP BEFORE YOU FILL THE GANTRY WATER SYSTEM. THE WATER PUMP IS DESTROYED IF YOU SWITCH ON THE WCS WITHOUT WATER.
- DO NOT MIX ANTI-FREEZE INTO THE CHILLED GANTRY WATER.

NOTE:

The procedure is the same for filling the W/W and W/A systems.

Refer to the appropriate image for your system in *Figure 7-17* when performing the following procedures.

The nominal static water pressure for the Gantry-WCS is **2 bar ±0.2 bar** when the WCS is switched off. Refill is mandatory when the pressure falls lower than 1.8 bar.


Drain Valve
Stop Valve (shown in Open Position)
Connection Point for Pressure Gauge
Drainage Hose
Filling Valve
Inlet Water Hose
Connection Point for Pressure Gauge
Drainage Valve
To Drainage Hose
To Inlet Water Hose
Filling Valve
Stop Valve (Shown in Closed Position

Water-Water

Water-Air

Figure 7-17: Filling the Water System

Preliminary Steps

1. Make sure that the water hoses to the Main (for Water-Water Cooling System only) and to the Gantry water supply are attached and tightened properly.
2. Set the three-way water valve in the Gantry right leg with a 5 mm Allen wrench (see *Figure 7-18*) as follows:
   a. Close the three-way water valve until the end stop by turning it counter-clockwise.
   b. Turn the valve clockwise for one rotation.
3. Close the Stop Valve (at WCS) by turning the red lever to the horizontal position.

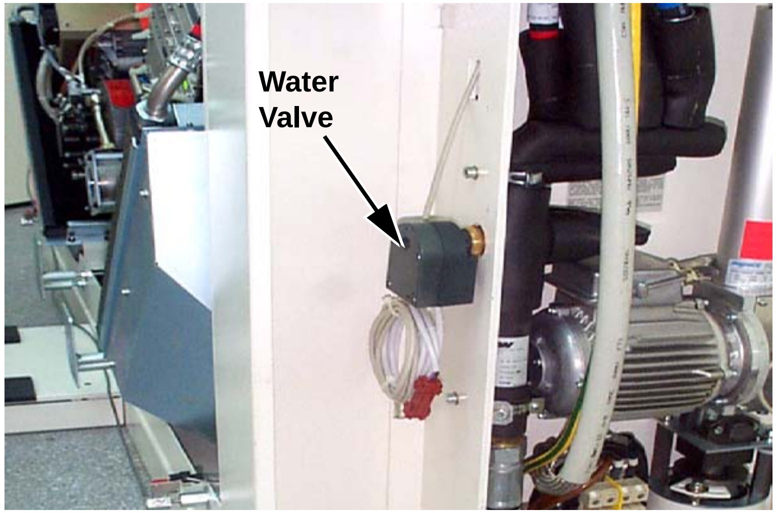


Figure 7-18: Three-Way Water Valve in the Right Leg of the Gantry

4. Close the Filling Valve by turning it clockwise until the mechanical end stop.
5. Connect the pressure gauge (delivered with the WCS) to the WCS Gantry Water Outlet (see *Figure 7-17*).
6. Make sure you have the two 1/2" water hoses available. The hose connectors are included with the WCS delivery kit (inside the WCS).

Water Filling Hoses Connection

1. Attach and tighten the brass connector to the filling /draining hose at one end of the hose. The brass connector is included in the WCS delivery kit.
2. Remove the brass cap from the Gantry Water Filling Valve at the WCS Gantry Water Inlet. The cap will be used later to open/close the valve.
3. Connect the water hose to the Filling Valve and tighten it.
4. Attach the water connection adapter to the other end of the water hose (obtain locally the appropriate adapter for the tap of the on-site water supply).
5. Connect the water connection adapter to a nearby water tap (on-site water supply) and tighten.
6. Attach and tighten the other brass connector to the drain water hose.
7. Remove the brass cap from the Drainage Valve at the WCS (next to the water pump). The cap will be used later to open/close the valve.
8. Connect the second water hose to the Gantry Water Drainage Valve and tighten.
9. The other end of the water hose must be routed and secured to a drain.

Filling Procedure

1. Open the Drainage Valve with one of the brass caps (turn counter-clockwise 90° so that the valve handle is parallel to the hose).
2. Make sure the WCS Gantry Water Stop Valve with the red handle is closed (the lever must be in horizontal position).
3. Make sure the Gantry Water Filling Valve at the WCS is closed by turning it clockwise until the mechanical end stop.
4. Open the water tap.
5. Slowly open the Gantry Water Filling Valve with the brass cap (to open, turn counter-clockwise). Water flows through the Gantry Water System Bypass.
6. Check the seals of all hose connections at the Gantry and WCS.
7. Let the water flow through the system for 5-10 minutes.
8. Open the three-way valve in the right gantry leg (see *Figure 7-18*) using the 5 mm Allen wrench (turn clockwise as far as possible).
9. Water now flows from the WCS to the Gantry. Let the water flow through the system for 30 minutes.
   Some air escapes from the internal air vent installed in the WCS (audible hiss).

⚠ CAUTION

TO AVOID SYSTEM DAMAGE IN THE NEXT STEP, MAKE SURE TO CLOSE THE GANTRY WATER FILLING VALVE **IMMEDIATELY** AFTER CLOSING THE GANTRY WATER DRAINAGE VALVE.

10. Close the Gantry Water Drainage Valve and **immediately** close the Gantry Water Filling Valve.
11. Open the Stop Valve by turning the red lever to the vertical position.
12. Open the Gantry Water Filling Valve and check the manometer. The water pressure should increase.
13. When the pressure reaches **2.2-2.5** bar, close the Gantry Water Filling Valve.
14. Close the water tap.

Final Steps

1. Check the seals of the Gantry hose-connection again.
2. Keep the hoses connected in case refilling is necessary during start-up.
3. To refill, open the water tap and then open the fill valve until reaching 2.2 bar on the manometer.
4. If pressure remains constant during the start-up process, remove the filling and drainage hoses.
5. Disconnect the filling water hose from the on-site water supply and then disconnect it from the WCS. Pour the remaining water in the hose down the drain.
6. Disconnect the draining water hose from the WCS and pour the water remaining in the hose, down the drain.
7. Reinstall the brass caps on the filling and drainage valves to prevent leakage.

> **NOTE:**
>
> IF THE WATER FLOW INTO THE GANTRY IS TOO STRONG (NOISE CAN BE HEARD) WHEN THE PUMP IS WORKING, CLOSE THE STOP VALVE BY 15 TO 30 DEGREES (SEE *Figure 7-19*).

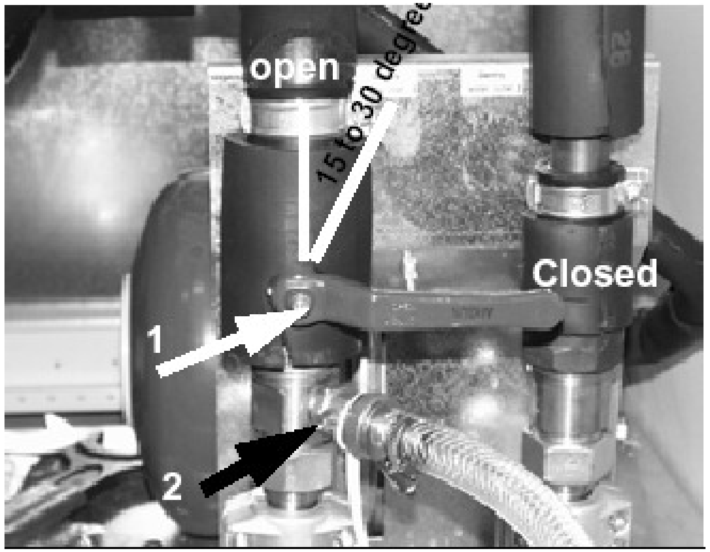


Figure 7-19: Closing Stop Valve to Reduce Pressure

Checking the Correct Pump Rotation in the Water Cooling System (WCS)

Verify that the WCS water pump rotates in the CW direction.
If the water pump rotates in the wrong direction, it will cause Gantry overheating.
Verify the rotation direction as follows:

1. Connect the pressure gauge to the water outlet (see *Figure 7-20*).
2. Turn ON all beakers in the WCS.
3. Verify that the pressure difference increase between pump On and pump OFF is approx. 1.5 Bar. If the pressure difference between pump On and pump OFF is 0.5 Bar or less, the pump rotation is wrong.

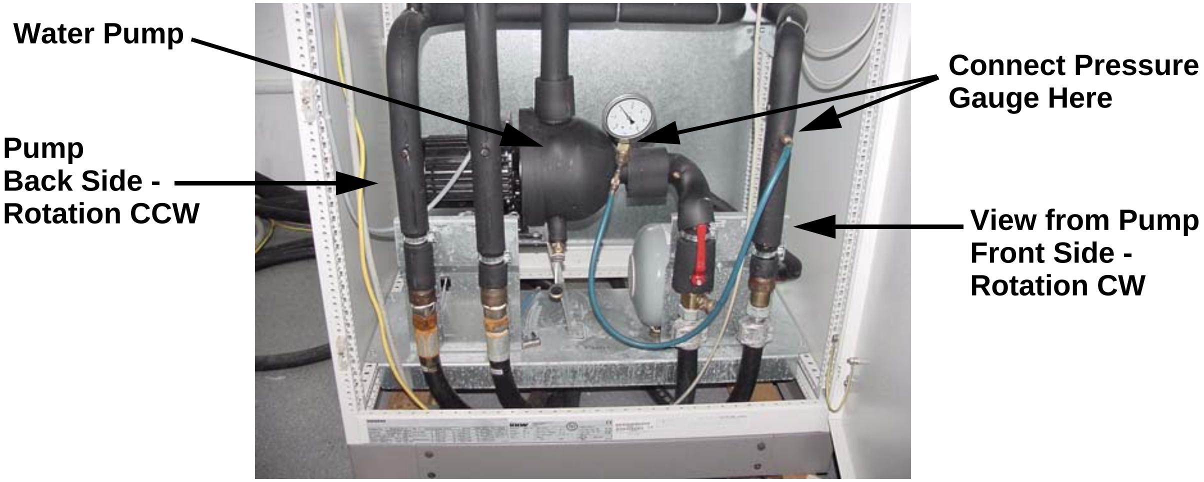

Water Pump
Pump
Back Side -
Rotation CCW
Connect Pressure
Gauge Here
View from Pump
Front Side -
Rotation CW

Figure 7-20: Pump Rotation Check

If pump rotation is incorrect, reverse the phases in X111 in the PDC.

Replacing the Permanent Bleeding Valve (Water-Water only)

Tools

- Standard FSE tool kit
- Absorbent cloth
- Manometer (included with the delivery of WCS)

Estimated Time

1 Person—0.5 hour

Removing the Valve

WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *"Safety Guidelines" on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

It is not necessary to drain the cooling system.

1. Switch off the WCS system via breaker F14 in the PDC.

NOTE:

Do not unscrew the valve adapter. This opens the water circulation system and allows water to escape.

2. Remove the insulation cap from the bleeding valve.
3. Place absorbent cloth under the permanent bleeding valve, since water may escape when the valve is opened.
4. Remove the bleeding valve by turning the valve housing (see *Figure 7-21*) counter clockwise.

   The valve is generally hand-tightened; therefore, no tools should be necessary to remove it.

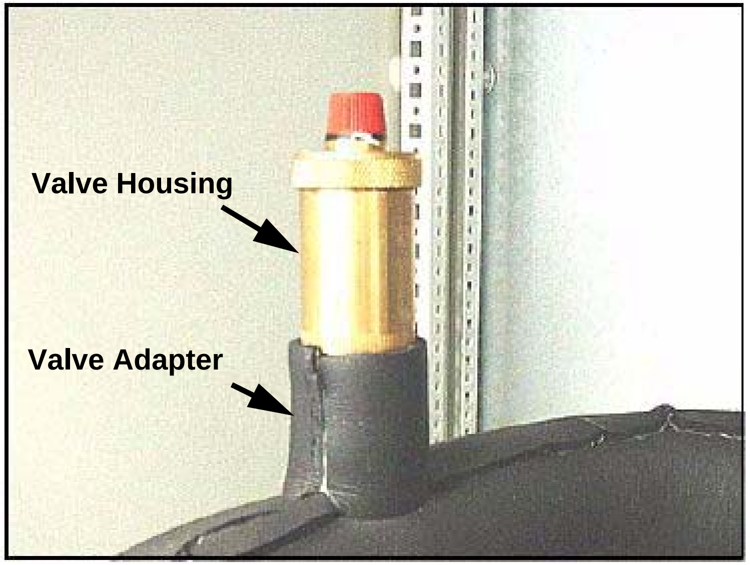


Figure 7-21: Permanent Bleeding Valve

Installing the Valve

1. Install the valve in the reverse order of removal.

NOTE:

The gaskets required in the water circulation system are included with the spare parts. Always use the new gaskets when replacing these parts.

2. Tighten the housing by hand only.
3. Install the insulation cap.

Final Steps

1. Check water pressure (the manometer should be connected at the WCS Gantry water outlet).

NOTE:

The nominal water pressure for the gantry water circuit is 2 bar± 0.2 bar) with the WCS switched off. Refilling is required if water pressure drops below 1.8 bar (see *“Filling the Water Cooling System”*).

2. Switch ON the WCS system with breaker F14 in the PDC.
3. Check the WCS for leaks.
4. Perform test scans.

Coolant System (Water-Air only)

⚠ WARNING

ONLY QUALIFIED SERVICE PERSONNEL ARE ALLOWED TO WORK WITH THE COOLING CIRCUIT OF WATER COOLING SYSTEM.

Tools

N/A

Estimated Time

N/A

⚠ WARNING

ONLY QUALIFIED SERVICE PERSONNEL IS ALLOWED TO WORK WITH THE COOLANT CIRCUIT OF THE WATER COOLING/AIR CONDITIONING SYSTEM. LIQUID TYPE KLEA 407C IS USED.

CONTACT YOUR LOCAL AIR CONDITIONING COMPANY TO PERFORM WORK INSIDE THE COOLANT CIRCUIT. THERE MAY BE HAZARDOUS CHEMICAL AND THERMAL REACTIONS DUE TO IMPROPER HANDLING OF THE COOLANT.

Spirovent Bleeding Device

Tools

- Standard FSE tool kit
- pipe wrench
- cable tie
- Absorbent cloth
- 2 water hoses with 1/2’’ connections
- Manometer (included with the delivery of WCS)

Estimated Time

1 Person—1.5 hour

Removing the Bleeding Device

WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

It is necessary to drain the cooling system prior to this procedure.

The spirovent bleeding device can be physically divided into two parts (see *Figure 7-22*):

- the lower part contains the bleeding mechanism
- the upper part contains no mechanical movable parts

Only the upper part of the spirovent bleeding device is authorized to be replaced in the field (FRU).

1. Switch off the WCS system via breaker F14 in the PDC system.
2. Place absorbent cloth under the spirovent, because water can escape when the connection is opened.
3. Drain the system as described in Section *“Draining Process”*.
4. Open the styrofoam cover of the spirovent by undoing the cable tie.
5. Turn the upper part of the spirovent in a counter clockwise direction.
6. When opening the connection, proceed with care if holding the lower part of the bleeding device with a pipe wrench.

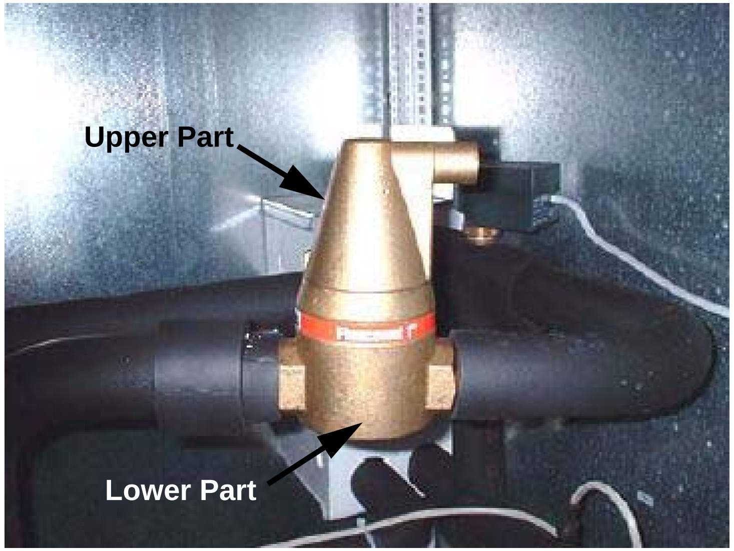


Figure 7-22: Spirovent Bleeding Device

Installing the Bleeding Device

Mount the new spirovent bleeding device by turning in a clockwise direction (see *Figure 7-22*).

NOTE:

To avoid bending the copper when tightening the connection, proceed with care if holding the lower part of the bleeding device with a pipe wrench.

Final Steps

1. Fill the WCS system as described in Section *“Filling the Water Cooling System”*.
2. Close the styrofoam cover of the spirovent. Secure the cover with a cable tie.
3. Switch on the WCS system with breaker F14 in the PDC system.
4. Check the WCS for leaks.
5. Perform test scans.

Temperature Sensor

Tools

- Standard tool kit
- Heat-conducting paste (HEAT SINK GREASE / item number 20 48 650)
- Manometer (included with the delivery of WCS)

Estimated Time

1 Person—0.5 hour

Removing the Temperature Sensor

⚠ WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

It is not necessary to drain the cooling system.

1. Switch off the WCS system via breaker F14 in the PDC.
2. Press the clip (see *Figure 7-23*) and disconnect the plug from the sensor.
3. Carefully lift the insulation at the bottom of the temperature gauge.
4. Loosen the screw.
5. Remove the temperature sensor.

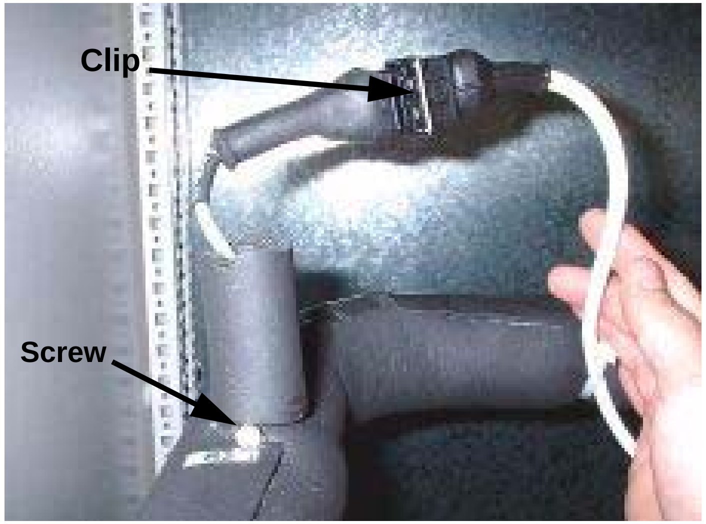


Figure 7-23: Temperature Sensor

Installing the Temperature Sensor

1. Install the new temperature sensor with heat conducting paste and mount it with the screw (see *Figure 7-23*).
2. Install the plug on the sensor.

Final Steps

1. Check water pressure (the manometer should be connected at the WCS Gantry water outlet).

> **NOTE:**
>
> The nominal water pressure for the gantry water circuit is 2 bar± 0.2 bar) with the WCS switched off. Refilling is required if water pressure drops below 1.8 bar (see *"Filling the Water Cooling System"*).

2. Switch ON the WCS system with breaker F14 in the PDC.
3. Check the WCS for leaks.
4. Perform test scans.

Adjustment Drive in the WCS (Water-Water only)

Tools

- Standard FSE tool kit
- Manometer (included with the delivery of WCS)
- Aluminum foil tape

Estimated Time

1 Person—0.5 hour

Removing the Adjustment Drive

WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *"Safety Guidelines" on page 1-1*. **FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.**

NOTE:

It is not necessary to drain the cooling system.

NOTE:

For 3-way valve replacement, see Chapter 3 Gantry, Section "Gantry Stationary Parts Replacement".

1. Switch off the WCS system via breaker F14 in the PDC.
2. Disconnect the electrical connection.
3. Remove the aluminum foil tape from the nut (see *Figure 7-24*).
4. Loosen the nut (see *Figure 7-24*) between the adjustment drive and the 3-way valve.
5. Remove the adjustment drive.

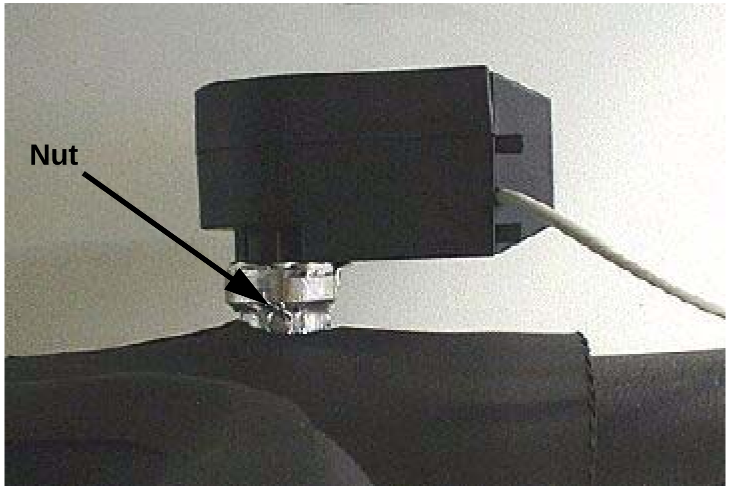


Figure 7-24: Adjustment Drive for 3-way Valve

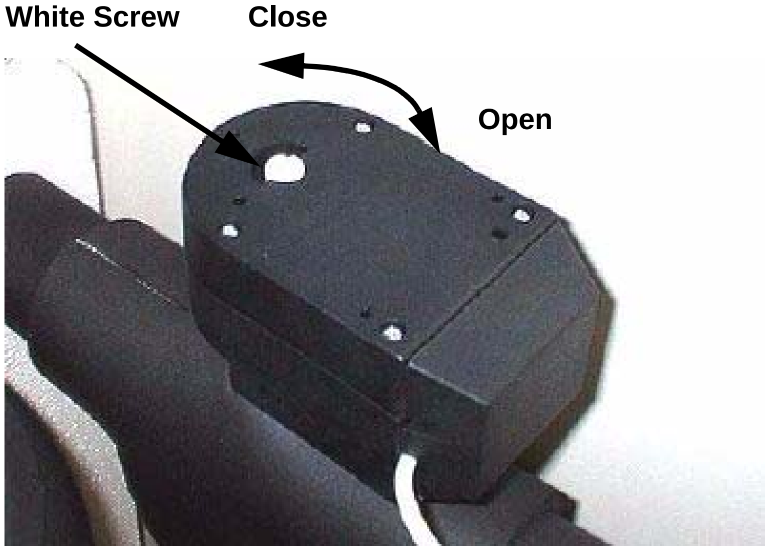


Figure 7-25: Adjustment Drive

Installing the Adjustment Drive

> **NOTE:**
>
> Before installing the new adjustment drive, the white screw (see *Figure 7-25*) must be in the counter clockwise end position (Position 0). Adjust it with a 5 mm allen wrench.

1. Install the new adjustment drive in the reverse order of removal.
2. Tighten the nut (see *Figure 7-24*) for the adjustment drive by hand only.
3. Install the aluminum foil tape on the holding nut (see *Figure 7-24*).

Final Steps

1. Check water pressure (the manometer should be connected at the WCS “Gantry water outlet”).

> **NOTE:**
>
> The nominal water pressure for the gantry water circuit is 2 bar± 0.2 bar) with the WCS switched off. Refilling is required if water pressure drops below 1.8 bar (see *“Filling the Water Cooling System”*).

2. Switch ON the WCS system with breaker F14 in the PDC.
3. Check the WCS for leaks.
4. Perform test scans.

3-way Valve (Water-Water only)

Tools

- Standard FSE tool kit
- 46mm wrench or crescent wrench
- Absorbent cloth
- 2 water hoses with 1/2” connections
- Manometer (included with the delivery of WCS)

Estimated Time

One Person—two hours

Removing the 3-way Valve

WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

It is necessary to drain the cooling system prior to this procedure.

1. Switch off the WCS system via F14 in the PDC system.
2. Place absorbent cloth under the 3-way valve, because water may escape when the connection is opened.
3. Drain the system as described in Section *Draining and Filling the Cooling System*.
4. Remove the adjustment drive prior to replacing the 3-way valve. Refer to Section *Adjustment Drive in the WCS (Water-Water only)*.
5. Cut the black insulation covering the 3-way valve with a knife and strip it.
6. Open the three nuts at the copper pipe connections with a 46 mm wrench.

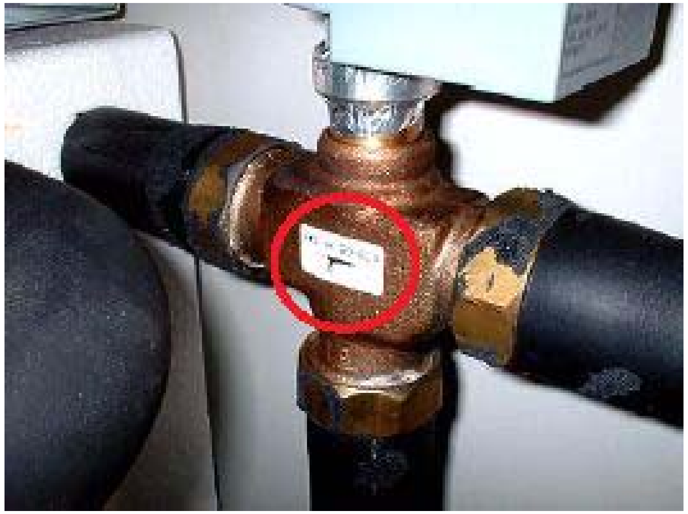


Figure 7-26: 3-way Valve

NOTE:

To avoid bending the copper when opening the connection, hold the pipe gently with a pipe wrench.

7. Remove the gasket from the each connection.

Installing the 3-way Valve

1. Install the new gasket to the each connection.
1. Install the new 3-way valve in such a way that the side marked " II " is connected to the heat exchanger in the back of the cabinet (see *Figure 7-26*).
1. Tighten the nuts with a 46 mm wrench.

⚠ CAUTION

TO AVOID BENDING THE COPPER WHEN TIGHTENING THE CONNECTION, HOLD THE PIPE GENTLY WITH A PIPE WRENCH.

Final Steps

1. Install the adjustment drive. Refer to Section *Adjustment Drive in the WCS (Water-Water only)*.
2. Fill the WCS system again as described in Section *Draining and Filling the Cooling System*.
3. Put the new insulation included with the new 3-way valve and secure it with cable ties.
4. Switch on the WCS system with breaker F14 in the PDC system.

NOTE:

The gaskets required in the water circulation system are included with the spare parts. Always use the new gaskets when replacing these parts.

5. Check the WCS for leaks.
6. Perform test scans.

Cooling Pump

Tools

- Standard FSE tool kit
- 25mm, 52 mm wrench or crescent wrench
- Pipe wrench
- Absorbent cloth
- 2 water hoses with 1/2” connections
- Manometer (included with the delivery of WCS)

Estimated Time

One Person—two hours

Removing the Cooling Pump

⚠ WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

It is necessary to drain the cooling system prior to this procedure.

1. Switch off the WCS system via F14 in the PDC system.
2. Place absorbent cloth under the 3-way valve, because water may escape when the connection is opened.
3. Drain the system as described in Section *Draining and Filling the Cooling System*.
4. Disconnect the electrical connection and cut the cable ties fixing the cable.
5. Remove the filling and draining valve assembly by opening the nut in a clockwise direction with a 27 mm wrench (see *Figure 7-27* and *Figure 7-28*).
6. Gently hold the valve assembly (see *Figure 7-28*) with a pipe wrench while opening the nut.
7. Shift the black insulation sleeves away from the two nuts.
8. Open the two nuts (see *Figure 7-27*) with a 52 mm wrench.

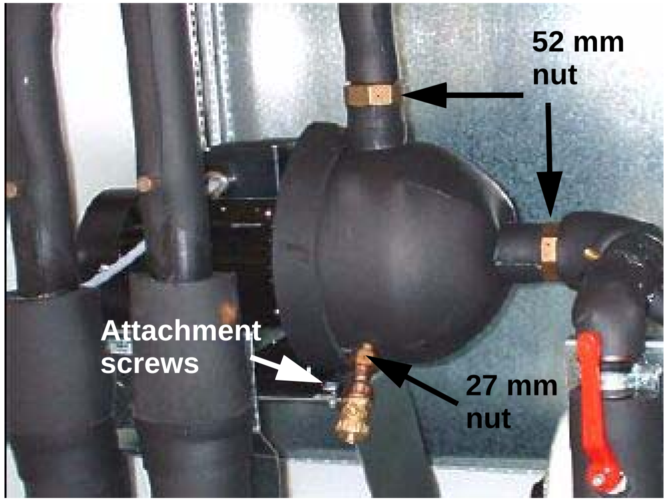


Figure 7-27: Cooling Pump

CAUTION

TO AVOID BENDING THE COPPER WHEN TIGHTENING THE CONNECTION, HOLD THE PIPE GENTLY WITH A PIPE WRENCH.

9. Loosen the 4 attachment screws (see *Figure 7-27*).
10. Remove the cooling pump.
11. Remove the gasket from the each connection.

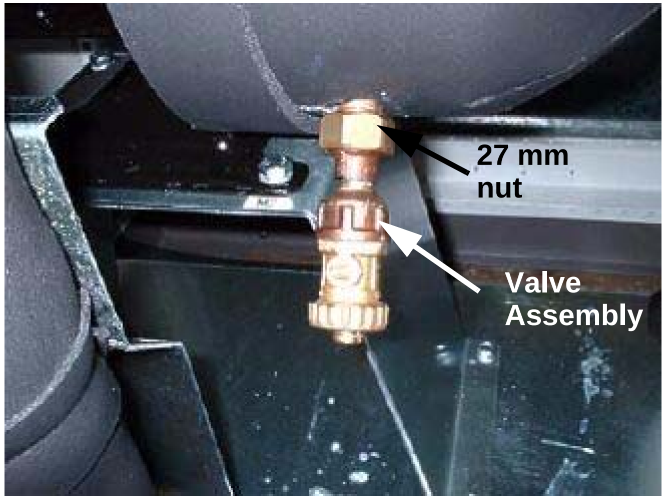


Figure 7-28: Valve Assembly

CAUTION

Be careful not to tear the insulation.

Installing the Cooling Pump

1. Install the new gasket to the each connection.

NOTE:

The gaskets required in the water circulation system are included with the spare parts. Always use the new gaskets when replacing these parts.

2. Install the new cooling pump in the reverse order of removal.

⚠ CAUTION

TO AVOID BENDING THE COPPER WHEN TIGHTENING THE CONNECTION, HOLD THE PIPE GENTLY WITH A PIPE WRENCH.

Final Steps

1. Fill the WCS system again as described in Section *Draining and Filling the Cooling System*.
2. Switch on the WCS system with breaker F14 in the PDC system.
3. Check the WCS for leaks.
4. Check correct pump rotation according to Section *Checking the Correct Pump Rotation in the Water Cooling System (WCS)*.
5. Perform test scans.

Checking the Correct Pump Rotation in the Water Cooling System (WCS)

Refer to the procedure on *page 7-43*.

Expansion Reservoir

Tools

- Standard FSE tool kit
- 30 mm wrench or crescent wrench
- Absorbent cloth
- 2 water hoses with 1/2” connections
- Manometer (included with the delivery of WCS)

Estimated Time

One Person—1.5 hours

Removing the Expansion Reservoir

⚠ WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

It is necessary to drain the cooling system prior to this procedure.

1. Switch off the WCS system via F14 in the PDC system.
2. Place absorbent cloth under the 3-way valve, because water may escape when the connection is opened.
3. Drain the system as described in Section *Draining and Filling the Cooling System*.
4. Open the nut (see *Figure 7-29*) at the copper pipe connection on the right side of the expansion vessel with a 30 mm wrench.

⚠ CAUTION

TO AVOID BENDING THE COPPER WHEN TIGHTENING THE CONNECTION, HOLD THE PIPE GENTLY WITH A PIPE WRENCH.

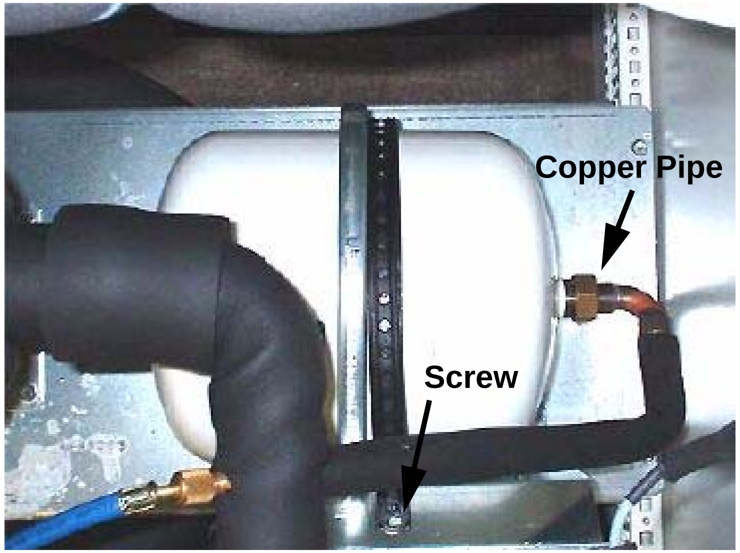


Figure 7-29: Expansion Reservoir

5. Open the screw (see *Figure 7-29*) that secures the expansion reservoir.
6. Remove the expansion reservoir.
7. Remove the gasket from the connection.

Installing the Expansion Reservoir

1. Install the new gasket to the each connection.
2. Install the new reservoir in the reverse order of removal.

⚠ CAUTION

TO AVOID BENDING THE COPPER WHEN TIGHTENING THE CONNECTION, HOLD THE PIPE GENTLY WITH A PIPE WRENCH.

Final Steps

1. Fill the WCS system again as described in Section *Draining and Filling the Cooling System*.
2. Switch on the WCS system with breaker F14 in the PDC system.
3. Check the WCS for leaks.
4. Perform test scans.

Flow Sensor (Water-Water only)

Tools

- Standard FSE tool kit
- 30 mm wrench or crescent wrench

Estimated Time

One Person—1.5 hours

Removing the Flow Sensor

⚠ WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

The primary (hospital) cooling circuit must be stopped and drained prior to replacing this parts. Please contact the person in charge of the primary water circuit.

1. Switch off the WCS system via F14 in the PDC system.
2. Stop and drain the primary (hospital) cooling circuit.
3. Disconnect the electrical connection.
4. Place absorbent cloth under the flow sensor, since water escapes when the connection is opened.
5. Loosen the nut (see *Figure 7-30*) with a 30 mm wrench.
6. Remove the flow sensor.

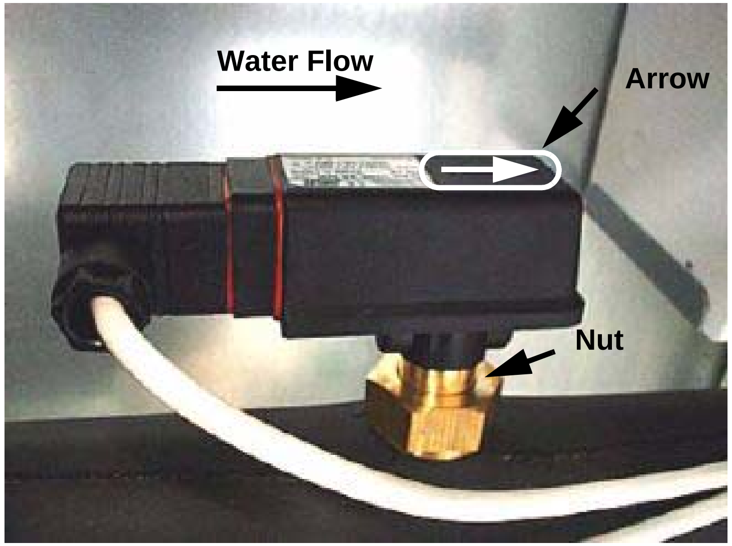


Figure 7-30: Flow Sensor

Installing the Flow Sensor

1. Install the new flow sensor in the reverse order of removal.

> ⚠ CAUTION
>
> THE FLOW SENSOR HAVE TO BE INSTALLED THE SAME DIRECTION AS THE WATER FLOW. MAKE SURE THE ALLOW MARK ON THE FLOW SENSOR LOOK TO THE RIGHT.

Final Steps

1. Start the primary (hospital) cooling circuit.
2. Switch on the WCS system with breaker F14 in the PDC system.
3. Check the WCS for leaks.
4. Perform test scans.

Filling and Draining Valve

Tools

- Standard FSE tool kit
- Absorbent cloth
- 2 water hoses with 1/2” connections
- Manometer (included with the delivery of WCS)

Estimated Time

One Person—1.5 hours

Removing the Filling and Draining Valve

⚠ WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

⚠ CAUTION

THE FILLING/DRAINING VALVE CAN ONLY BE CHANGED BY A PLUMBER, BECAUSE IT MUST BE SEALED WITH HEMP.

NOTE:

It is necessary to drain the cooling system prior to this procedure.

1. Switch off the WCS system via F14 in the PDC system.
2. Place absorbent cloth under the 3-way valve, because water may escape when the connection is opened.
3. Drain the system as described in Section *Draining and Filling the Cooling System*.

The filling/draining valve can be removed by a plumber.

Installing the Filling and Draining Valve

The filling/draining valve can be installed by a plumber.

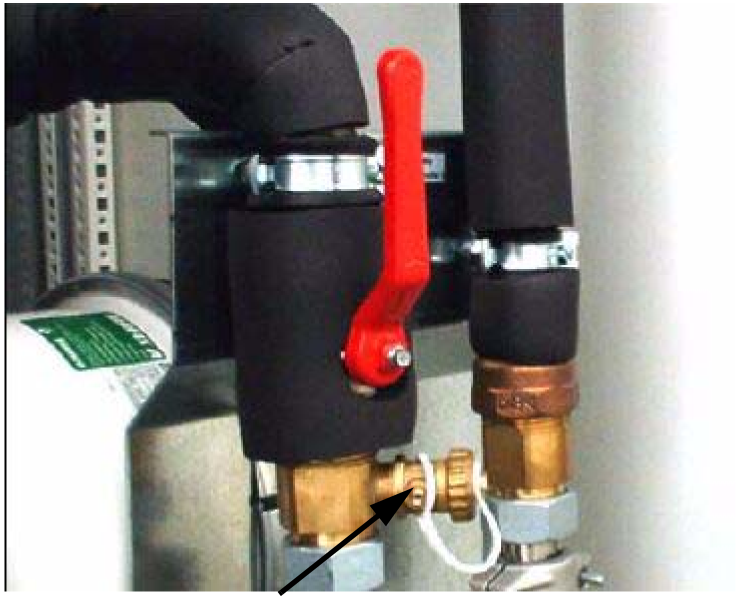


Figure 7-31: Filling and Draining Valve

Final Steps

1. Fill the WCS system again as described in Section *Draining and Filling the Cooling System*.
2. Switch on the WCS system with breaker F14 in the PDC system.
3. Check the WCS for leaks.
4. Perform test scans.

Shut-off Valve

Tools

- Standard FSE tool kit
- Absorbent cloth
- 2 water hoses with 1/2” connections
- Manometer (included with the delivery of WCS)

Estimated Time

One Person—1.5 hours

Removing the Shut-off Valve

⚠ WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*. **FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.**

⚠ CAUTION

THE FILLING/DRAINING VALVE CAN ONLY BE CHANGED BY A PLUMBER, BECAUSE IT MUST BE SEALED WITH HEMP.

NOTE:

It is necessary to drain the cooling system prior to this procedure.

1. Switch off the WCS system via F14 in the PDC system.
2. Place absorbent cloth under the 3-way valve, because water may escape when the connection is opened.
3. Drain the system as described in Section *Draining and Filling the Cooling System*.

The filling/draining valve can be removed by a plumber.

Installing the Shut-off Valve

The filling/draining valve can be installed by a plumber.

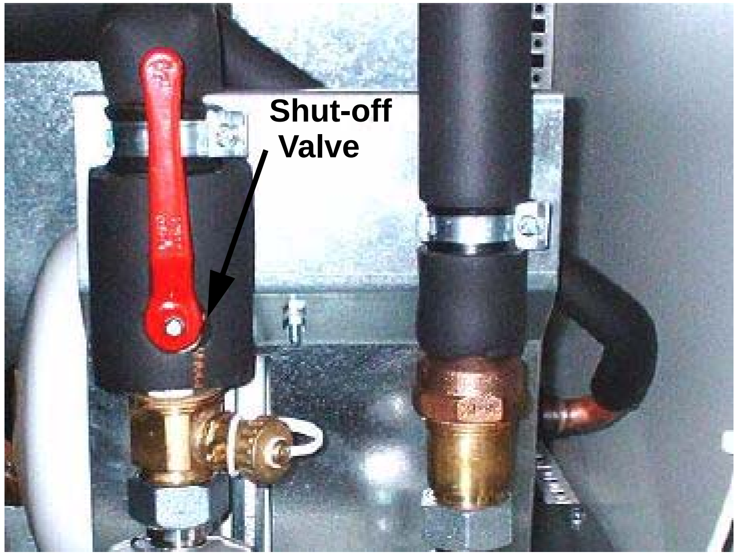


Figure 7-32: Shut-off Valve

Final Steps

1. Fill the WCS system again as described in Section *Draining and Filling the Cooling System*.
2. Switch on the WCS system with breaker F14 in the PDC system.
3. Check the WCS for leaks.
4. Perform test scans.

Temperature Sensor in the Air Inlet (Water-Air only)

Tools

Standard FSE tool kit

Estimated Time

1 Person—1 hour

Removing the Temperature Sensor

⚠ WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

It is not necessary to drain the cooling system.

1. Switch off the WCS via breaker F14 in the PDC.
2. Disconnect the air pipe to the WCS.

> **NOTE:**
>
> The temperature sensor can be accessed via the air inlet in back of the WCS, either to the left or to the right.

3. Press the clip (see *Figure 7-33*) and disconnect the sensor from the plug.

Installing

1. Connect the new sensor to the plug.
2. Connect the air pipe.

Final Steps

1. Switch on the WCS via breaker F14 in the PDC.
2. Perform test scans.

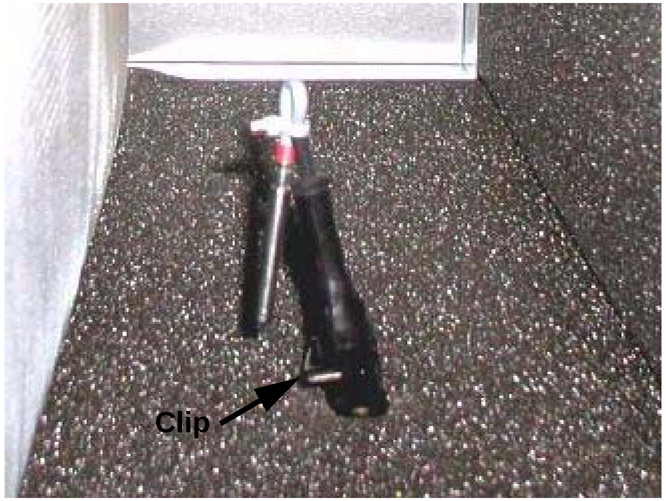


Figure 7-33: Temperature Sensor in the Air Inlet

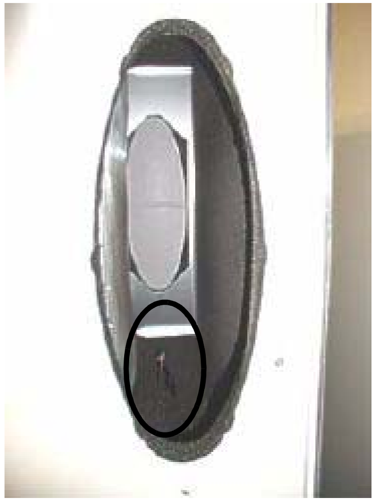


Figure 7-34: WCS W/A -side view- air inlet

Fan (Water-Air only)

Tools

Standard tool kit

Estimated Time

2 Persons—1.5 hours

Removing the Fan

⚠ WARNING

**FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN *“Safety Guidelines” on page 1-1*.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.**

NOTE:

It is not necessary to drain the cooling system.

1. Switch off the WCS system via breaker F14 in the PDC.

NOTE:

For easy access to the parts to be replaced, remove the electronic plate prior to starting work.

2. Remove the cover from the electronic plate.
3. Disconnect the electrical connection.
4. Cut the cable ties securing the cable.
5. Remove the four screws securing the electronic plate using a 10 mm wrench (see *Figure 7-35*).
6. Pull out the assembly toward the front carefully.

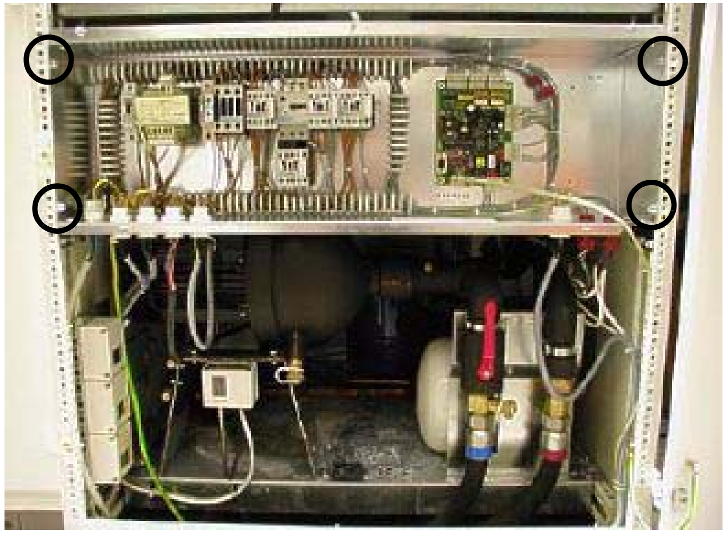


Figure 7-35: Electronic Plate in WCS

WARNING

THE WEIGHT OF THE FAN WITH THE MOUNTING PLATE (SEE *Figure 7-36*) IS APPROX 40 KG. REMOVAL AND INSTALLATION OF THE ASSEMBLY REQUIRES TWO PEOPLE.

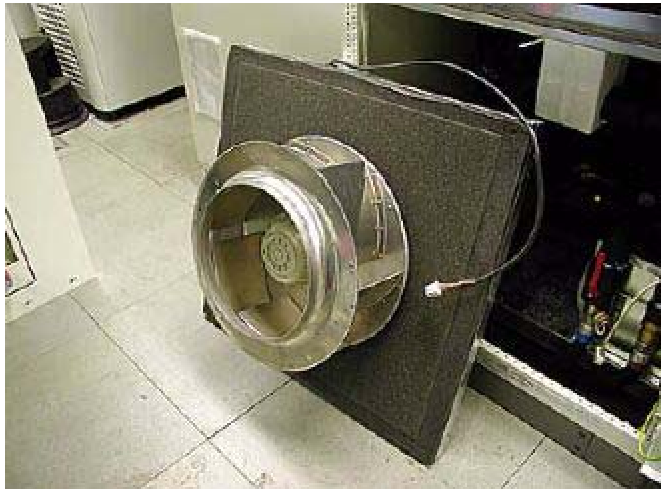


Figure 7-36: Fan with mounting plate

7. Remove the five screws securing the mounting plate using a 10 mm wrench (see *Figure 7-37*).
8. Pull out the assembly toward the front carefully.
9. Place the assembly flat on the floor facing upward. Proceed with care.
10. Remove the insulation glued onto the mounting plate over the cable.
11. 5. Remove the eight screws (see *Figure 7-38*) with a 17 mm wrench.
12. Separate the mounting plate from the fan motor and the squirrel cage.

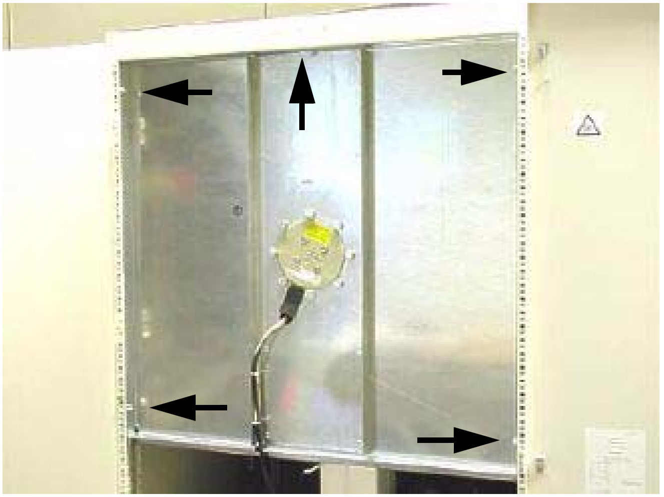


Figure 7-37: Mounting plate

Installing the Fan

1. Carefully place the new fan motor and squirrel cage on the floor with the motor facing upward (see *Figure 7-38*).
2. Route the cable through the hole in the mounting plate, put the plate on the motor, and secure it with eight screws (see *Figure 7-38*) using a 17 mm wrench.
3. Install the new self-adhesive insulation included with the delivery over the cable.
4. Carefully install the assembly back into the cooling cabinet.
5. Tighten the five screws using a 10 mm wrench (see *Figure 7-37*).

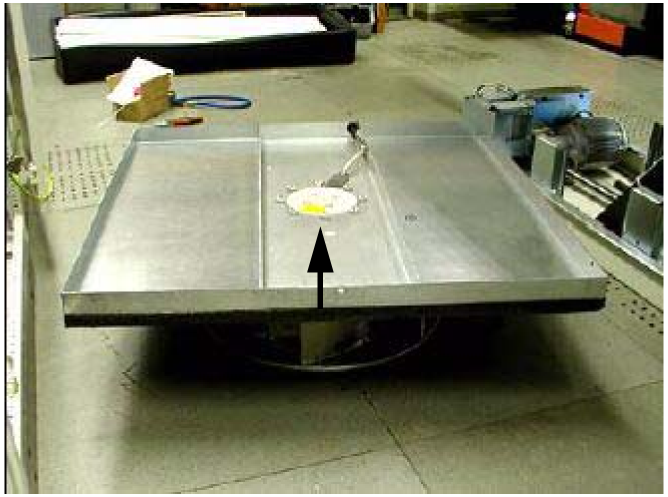


Figure 7-38: Mounting plate on the floor

Final Steps

1. Install the electronic plate in the reverse order of removal.
2. Connect the cable and secure it with cable ties.
3. Install the cover of the electronic plate.
4. Switch on the WCS via breaker F14 in the PDC.
5. Perform test scans.

Chapter 8
Network Configuration

Network Installation and Configuration 8-1

Mx8000 Network Configuration 8-3

Network Configuration Terminology 8-5

Using the Configuration Dialog Boxes 8-7

- Setting the IP Address 8-8
- Routing and Gateway 8-9
- Display Actual Current Ethernet Speed (10/100) 8-11
- Configuration Procedure 8-12
- Backing Up LAN Configuration Files to a Floppy 8-12
- Backing Up LAN Configuration Files to an EOD 8-13
- Adding Nodes 8-14
- Removing Nodes 8-14
- Opening the Node Configuration Dialog Box 8-14
- Device Configuration 8-17
- Adding HIS/RIS to the Mx8000 8-28
- Configuration Instructions 8-29

Site Manager 8-31

- Overview 8-31
- Configuring the Mx8000 to Recognize the SiteManager 8-32
- Configuring the SiteManager to Recognize the Mx8000 8-34

Device Configuration 8-35

Mx8000 Workstation Export Function 8-47

- Creating an Export Device (Configuration) 8-47
- Exporting Images to a Floppy, or a DICOM Station 8-49
- Exporting images Directly to the EOD 8-50
- Transfer Syntax 8-51

Mx8000 Workstation Import Function 8-52

- Creating an Import Device (Configuration) 8-52
- Importing Images 8-52
- Transfer Syntax 8-53

LAN Configuration in MxTwin Station Connected to Mx8000 Workstation 8-54

Mx8000 LAN Configuration Features 8-56

- Pushing Images from MxTwin to the Mx8000 (without a PassPort) 8-56
- Pushing Images from a MxTwin Scanner to a Foreign DICOM Workstation Using the Mx8000 as a Transparent Gateway 8-65

Network Connection Testing and Troubleshooting 8-69

- Network Testing 8-69
- Diagnosing Software Problems 8-75
- Disabling the Workstation Password 8-75

Network Installation and Configuration

The Mx8000 workstation features full compliance with DICOM 3.0 standard and comprehensive connectivity to Philips scanners.

Mx8000 Host communication with other stations is based on the DICOM-3 standard. This enables the Mx8000 to communicate with any DICOM-3 compliant products (including scanners from other vendors, workstations and hardcopy units). The Mx8000 can send/retrieve images to/from other stations and other stations can retrieve/send images from/to the Mx8000.

The Mx8000 can function both as a server and as a client. Images are transferred in the DICOM-3 protocol, based on TCP/IP as a transport layer and on Ethernet as a data-link layer.

Communication is through an Ethernet network meeting IEEE 802.3 specifications. The supported media type is:

- **10/100 BaseT -** This network option supports connection to a wiring switch by twisted pair cables with RJ-45 connectors. This option supports a maximum length of 100 m using shielded or unshielded cables. The basic option includes a 2 m 10BaseT cable.

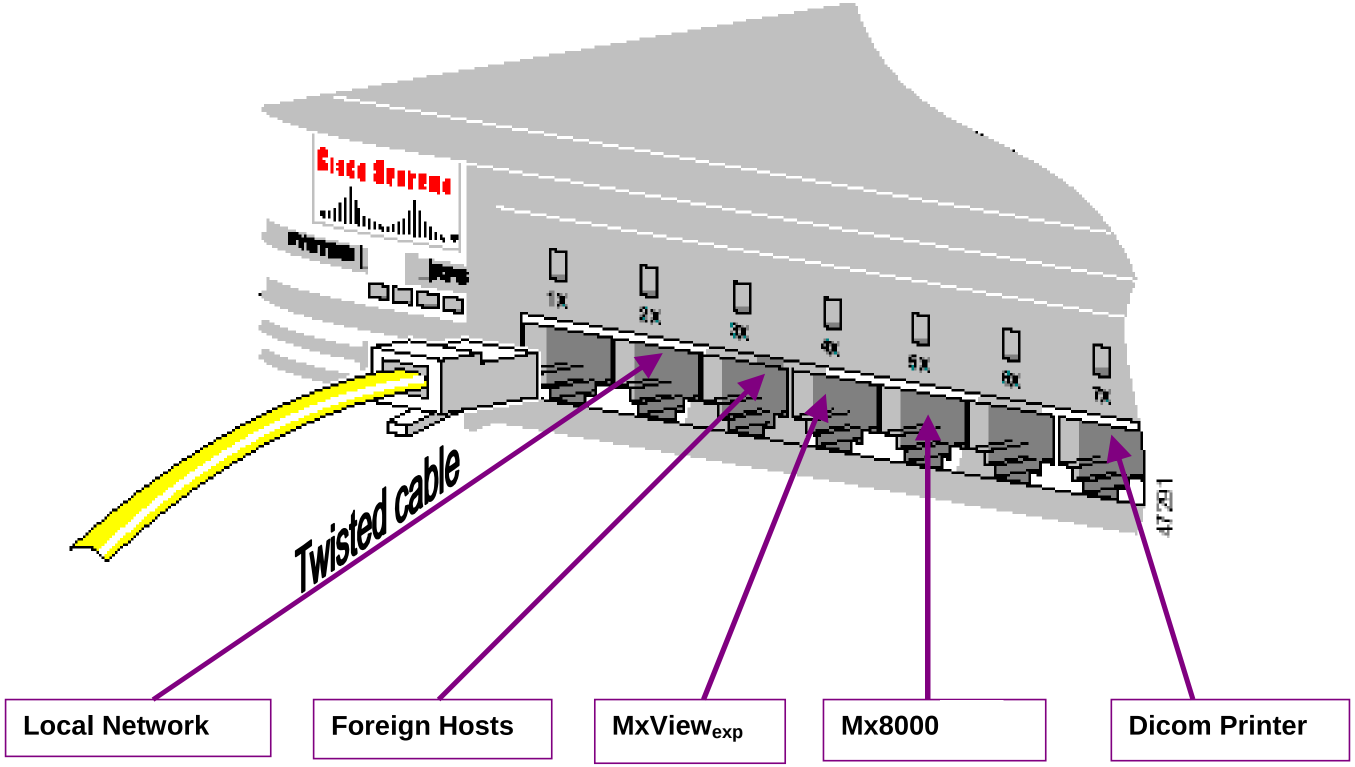

Cisco Systems
1x
2x
3x
4x
5x
6x
7x
Twisted cable
47291
Local Network
Foreign Hosts
MxView$_{exp}$
Mx8000
Dicom Printer

Figure 8-1: Network Block Diagram

Hardware connection media are transparent to the network software.

For network configuration see *“Mx8000 Network Configuration”*.

Mx8000 Network Configuration

This chapter explains how to customize the network configuration of the Mx8000 workstation for site-specific requirements.

In Network Configuration, define all the devices and systems that are connected to the Mx8000 workstation:

- Devices connected directly to the Mx8000 (such as Hard disk, EOD Drive, AMC)
- Systems connected via the Ethernet network to the Mx8000 (such as CT scanners, DICOM compatible devices, etc.)

Perform Network Configuration by opening dialog boxes (Network, Node Configuration, and Device Configuration dialog boxes) and entering the parameters that correspond to your Mx8000 Workstation configuration.

This section includes the following:

- *“Network Configuration Terminology”*
- *“Using the Configuration Dialog Boxes”*
- *“Setting the IP Address”*
- *“Routing and Gateway”*
- *“Configuration Procedure”*

> **NOTE:**
>
> When connecting the Mx8000 to the network, also configure all other systems on the network so that they recognize the Mx8000 workstation. For configuration instructions see the documentation accompanying these devices.

When connecting the Mx8000 to another DICOM compatible station (scanner/printer), you must provide the other station with the Internet Address (IP) of the Mx8000 workstation, AE Title of the disk, and the port number. You may also need to provide all the AE Titles of other devices such as: Disk, Memory, EOD, Archive Manager, Memory Manager, Spooler.

NOTE:

Our default port number is 104.

When connecting the Mx8000 to a CT-Twin scanner, you must perform LAN configuration in the CT-Twin scanner.

When you connect the Mx8000 workstation to the network, configure all the other systems on the network, so that they recognize the Mx8000 workstation. For configuration instructions see the documentation accompanying each device.

When you connect the Mx8000 workstation to another DICOM compatible station, provide the other station with the Internet Address of the Mx8000 workstation, and the name and AE title of some of devices, such as: disk, memory, temp disk, EOD, AMC, Archive Manager, Memory Manager, spooler, film Previewer.

Network Configuration Terminology

The following terms relate to network configuration.

This section includes definitions of terminology relating to Network Configuration.

DICOM

Digital Imaging and Communications in Medicine. A standard defining image format and communication protocol between medical imaging stations

Network Connection

The **Mx8000** can be connected to other **Mx8000** stations, CT scanners, and DICOM-3 compliant scanners, workstations, printers and laser imagers through an Ethernet network.

Internet Address (IP)

All devices on the network have a unique Internet Address.

The format of the Internet Address is **x. y. z. and w** where **x**, **y**, **z**, and **w** are integers between 0 to 255 (e.g. 192.1.1.1). These 4 integers are divided into 2 fields:

- The first (left-most) field is called the network address and should be identical for all the nodes in the network (unless routing is used).
- The second field is the node address and must be unique for each node in the network.

The format of the network and node addresses is determined by the following rule:

A. If **x** is between 0-127, the network is called a “Class A” network.
In this case, the network address consists only of **x**, and the node address consists of **y.z.w**.

B. If **x** is between 128-191, the network is called a “Class B” network.
In this case, the network address is **x.y**, and the node address is **z.w**.

C. If **x** is between 192-255, the network is called a “Class C” network. In this case, the network address is **x.y.z**, and the node address is **w**.
This is the most common type of network.

Netmask

A custom netmask can be defined (a logical grouping of the systems in the network). However, the default netmask should be used unless the network administrator at the site assigns a custom netmask.

Node

Each DICOM-3 compliant station in the network (Ethernet) is considered a node for Network Configuration purposes.

The nodes fall into three categories:

- The local **Mx8000** workstation to be configured
- Remote **Mx8000** workstations connected to the local one
- Other DICOM-3 compliant scanners, workstations etc.

Device

Each node can include one or more devices. A device can be used to import data (for example, a scanner which produces images), to store and handle the data (for example, the local disk which stores images), or to export data (for example, an export device which is used to export film images).

AE Title

Each device has a unique logical address in DICOM communication. This logical address is called AE Title.

Using the Configuration Dialog Boxes

This section explains how to use Network Configuration dialog boxes.

Data fields

Data fields are used to view and edit data. Data can be changed by clicking on the field and typing in the data.

Use the Left or Right arrow keys and the **<Backspace>** key to edit the data in the field. When exiting the field area (by clicking the mouse outside the field, the validity of the data is checked. If the field is not legal (for example, it contains an illegal character or an integer which is out of range), the field will be highlighted.

Expert mode

The **Node Configuration** dialog box and the **Device Configuration** dialog box include an **Expert mode** toggle button. This button toggles between basic configuration mode and expert configuration mode.

In the basic mode the dialog box contains fields which are usually changed. The expert mode adds additional fields which should rarely be changed.

⚠ CAUTION

DON'T CHANGE THE VALUE OF ANY FIELD IN EXPERT MODE UNLESS YOU ARE ABSOLUTELY SURE OF WHAT YOU ARE DOING.

Ok Button

Each dialog box has an **Ok** button. Click the **Ok** button to confirm the current setting of the dialog box. If the current setting is legal, the dialog box closes. If the current setting is not legal (for example, one of the data fields is empty), a corresponding message appears, and the dialog box remains open. The new network configuration takes effect only after you click **Ok**.

Cancel Button

Click the Cancel button to close the dialog box and cancel all changes which were made.

Setting the IP Address

The IP address consists of four fields (for example 192.132.141.211). The first three fields are the IP network address. The fourth field is the node address of the local workstation.

The local Mx8000 workstation and the other computer should be configured to have the same IP network address, so that they can access one another over the Ethernet. (the first three numbers of their IP addresses should be the same).

Computers on the same network should have individual node numbers.

To set the IP address of the Mx8000 workstation:

1. Log in as **root** (use password: **pkserv99**).
2. From the **System** menu in the toolchest, select **System Manager**. The **System Administration** window opens.
3. In the menu at the left of the **System Administration** window select **Network and Connectivity,** and in the menu at the right select **Network Interface Manager**. The **Network Interface Manager** window opens.
4. Click **Configure**.
5. In the next window, click **Next**.
6. In the next window, click **Next**.

NOTE:

We do not recommend the use of DHCP because DICOM protocol uses static IP and AE-Title.

7. Type in the IP Address in the appropriate field. Verify that the **Use default netmask** checkbox is selected.
8. Click **Next**.
9. Click **OK** to confirm your settings.
10. Close all open windows. Restart is not required.

NOTE:

After setting the IP Address, the system is automatically set to Network Mode (as opposed to Standalone Mode).

Routing and Gateway

NOTE:

Use Gateway and Routers only after you consult with the network system administrator.
There is generally a need to use only Gateway or Router, however, there are cases that both of them are needed.

Add routing and gateway addresses to the static_route option as in the example listed below:
Open a Unix shell. At the prompt IRIS #1 type: **nedit /etc/config/static-route.options** and press **<Enter>.**

```
# static-route.options
#
# The network startup script, /etc/init.d/network, invokes this
# script to set static routes. Site-dependent static routes should
# be put here.
#
# Because name services are not active when this file is invoked, any
# names used here should be defined in /etc/hosts.
#
# Read `man route`.
# Since $ROUTE and $QUIET are set in /etc/init.d/network, it is convenient
# to use `route` commands similar to the following here:
#
```

```
# Since $ROUTE and $QUIET are set in /etc/init.d/network, it is convenient
# to use `route` commands similar to the following here:
#
# $ROUTE $QUIET add -net 10 192.0.2.3
# or
# $ROUTE $QUIET add 192.168.1.1 192.0.2.5
$ROUTE $QUIET add default 62.0.62.126 (Exp. for Default Gateway)
$ROUTE $QUIET add 172.16.0.0 62.0.62.100 (Exp. for Router)
```

NOTE:

The 172.16.0.0 is the target network that you need to reach (a specific IP can be define instead).
The 62.0.62.100 is the Router IP (this IP it must be in your network).

Display Actual Current Ethernet Speed (10/100)

Ethernet Speed

For **IRIX 6.5** type: **ifconfig -v ec0** and press **<Enter>**. The connection speed appears on screen.

For **IRIX 6.3** type: **ifconfig ec0 debug** and press **<Enter>**.
type: **ifconfig ec0 -debug** (for cancel debug mode).

The Ethernet speed appears in **/var/adm/SYSLOG**. Type: **tail -10 /var/adm/SYSLOG** and press **<Enter>.**

Configure the O2 to Use Full Duplex and not Auto Select

The O2 systems are auto sensing. If you connect them to a 10/100 switch, the system indicates that you are connecting to 100 full duplex without configuring. However, if you are connecting to a 10/100 hub, you get only half 10/100 because the hubs are not full duplex.

1. Turn on the O2 and click stop for the maintenance.
2. Press **5** to enter the command monitor.
3. Type: **setenv -p ec0mode XXX** and press **<Enter>**.

NOTE:

Where XXX =F100—full duplex 100 MBS
F10—full duplex 10 MBS
H100—half duplex 100 MBS
H10—half duplex 10 MBS

4. Type: **init** and press **<Enter>**.

To reset the mode and speed to default (auto sense), type: **unsetenv ec0mode** and press **<Enter>**.
After the above is completed, turn the power OFF to the O2 and then start.

Configuration Procedure

1. Logout (if you are logged in) and login as **config** (password **mxconfig**). The main configuration menu appears. It currently has two fields:
   - **Network Configuration**—for changing the network configuration.
   - **Exit**—for terminating the configuration.

2. Click **Network Configuration**. The Network Configuration dialog box is displayed. The dialog box enables the following:
   - Backup of LAN Configuration files
   - Addition of nodes to the network
   - Removal of nodes from the network
   - Opening a node dialog box to change its parameters

⚠ CAUTION

IF YOU CHANGE THE NETWORK CONFIGURATION, THE IMAGES WAITING IN THE QUEUE TO BE COPIED OR TO BE PRINTED ARE CLEARED. IN ADDITION, THE WORKSTATION IS AUTOMATICALLY REBOOTED WHEN YOU TERMINATE THE CONFIGURATION SESSION.

Backing Up LAN Configuration Files to a Floppy

Backup the LAN Configuration files before making any changes. Backup LAN Configuration files as follows:

1. Login as **config** (password: **config95**).
2. Click **Network**. The Network dialog box opens.
3. Insert a formatted diskette into the floppy drive.
4. Verify that the system identifies the diskette as follows:

a. Open a winterm session (password: **letmein**).
b. Type: **df -k** and press **<Enter>**.
c. If the system identifies the diskette, the following message appears:
dev/rdsk/fds0d2.3.5hi dos .../floppy
d. If the above message does not appear, repeat step 4b until it does.

If after repeating step 4b several times the message still does not appear, insert another floppy diskette.

5. Click **"additional read/write operations..."**.
6. Click **write floppy.**
7. Eject the floppy and set it to "write protect".

Backing Up LAN Configuration Files to an EOD

1. Login as **MD**.
2. Insert a formatted EOD media in to the drive and mount it with the EOD icon.
3. Open a Unix shell (root) in the background.
4. Type: **cp -rp /usr/tamar.root/cfg/Arc /EOD/3** and press **<Enter>.**
5. Type: **cp -p /etc/hosts   /EOD/3** and press **<Enter>.**
6. Type: **cp -p /etc/config/static-route.options /EOD/3** and press **<Enter>.**
7. Type: **cd /** and press **<Enter>.**
8. Eject the EOD with the EOD icon.
9. Type: **reboot** and press **<Enter>**.

Adding Nodes

NOTE:

Use the **Mx8000** option when configuring node for Mx8000 / OmniPro / Mx8000 / SeleCT.
Use **Other** for all other nodes such as PACS, Scanner, DICOM printer, etc.

Add a node to the network as follows:

1. Click **Add ....** A list of types of available nodes (**Mx8000** or others) appears.
2. Click on the required option. A small dialog box opens.
3. Type in the name of the new node, and click **OK**. The relevant Node Configuration dialog box opens.

Removing Nodes

Remove a node from the network as follows:

1. Select the node by clicking it.
2. Click **Remove Node**.

Opening the Node Configuration Dialog Box

To open the Node Configuration dialog box, double-click on the node. The Node Configuration dialog box opens.

Node Configuration

The **Node Configuration** dialog box is used to configure an existing Mx8000 or a new node.

The dialog box enables you:

- To change the parameters (fields) of the node
- To add devices to the node
- To remove devices from the node
- To change the parameters of an existing device

Changing Node Configuration Fields

The Node Configuration dialog box includes a set of fields. The fields change according to the configuration of the Mx8000 workstation. To change a field, click it and make the required change.

Table 8-1: Basic Node Fields

FIELD NAME	DESCRIPTION	SYNTAX
Name	The name of the node. Used to create the default names and AE Titles for devices in the node.	1-6 characters. Each character is either a letter, a digit, a minus sign (-) or an underscore (_).
IP (only if the node is not the local Mx8000):	The internet address of the node.	x.y.z.y where x,y,z,w are integers between 0 and 255. It is recommended not to use 0 and 255.

Table 8-2: Node Fields that Appear Only in Expert Mode

FIELD NAME	DESCRIPTION
Port	The port number that is used by the devices in the node for DICOM communication (unless another port is defined for the device). The default is the DICOM standard port (104).
ARTIM	Time-out (in seconds). Used in DICOM communication. By default 5 sec.
Client_Devices (only if the node is the local Mx8000)	A list of devices used as DICOM clients on the Mx8000. Normally, these devices should not be changed.

Changing Device Parameters, and Adding and Removing Devices

The Node Configuration dialog box includes a scroll list of the existing devices in the node.

1. Add a device to the node as follows:
   a. Click **Add ...**. A list of device types which can be added is displayed.
   a. Click on the required device. The Add Device dialog box opens. Enter the device name. To verify the settings, click **OK**.
2. Remove a device from the node as follows:
   a. Select the device by clicking it.
   b. Click **Remove Device**.

NOTE:

The following devices cannot be removed: Disk, Memory, Temp Disk, and Demo.

3. To change the parameters of an existing device, double-click the device in the existing device field. The Device Configuration dialog box opens. Make the required changes.

Device Configuration

Local Node Devices:

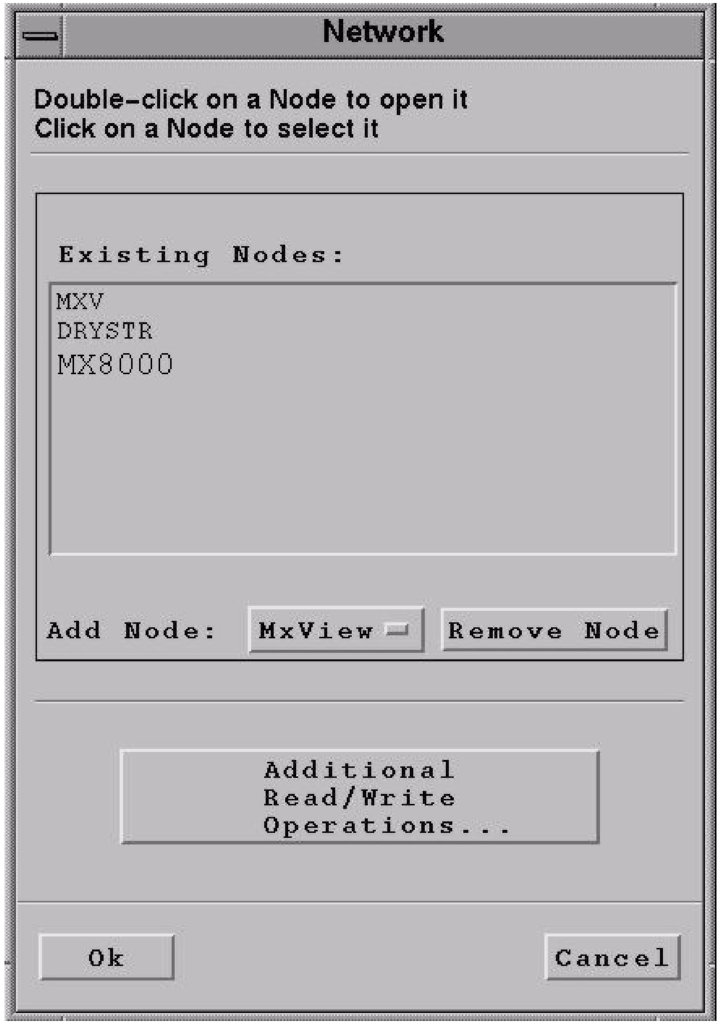
Local	The local hard disk of the Mx8000 (see *Figure 8-4* and *Figure 8-5*)
Memory	The memory of the Mx8000 (see *Figure 8-6*)
Temp-disk	Used for temporary storage on the Mx8000
StorageCommitment	DICOM Storage Commitment SCP (for incoming reports)
EOD	Erasable Optical Disk (see *Figure 8-7*)
AMC (Print)	A laser imager connected through an AMC box (see *Figure 8-8*)
CT Station	A MxTWIN scanner or OmniView/GVS workstation (see *Figure 8-9*)
Export	Used to export images to files
Import	Used to import DICOM images
Folder	Local disk folder
CD	CD-ROM of the O2 (read-only) (see *Figure 8-10*)
CDR	CD Recorder (see *Figure 8-11*)

NOTE:

Because DICOM protocol is case sensitive, it is recommended that, to avoid mistakes, you use capital letters (upper case) when filling-in the AE Title fields.

Dialog Boxes For Different Network Configurations

This section shows **Network Configuration** dialogs for different Mx8000 configurations. Perform network configuration with the examples that correspond to your Mx8000 configuration.

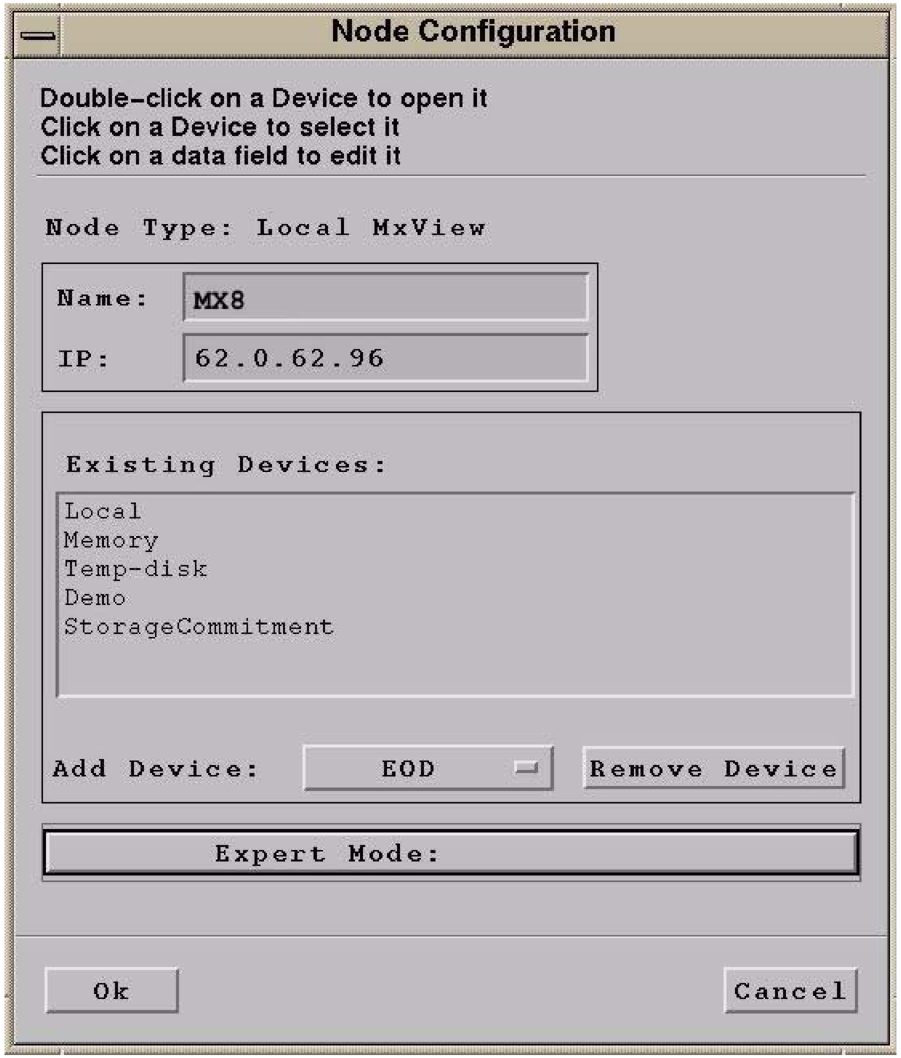


Double-click on a Node to open it
Click on a Node to select it

Existing Nodes:
MXV
DRYSTR
MX8000

Add Node: MxView

Figure 8-2: Network Configuration Dialog Box


Node Configuration
Add Device:
EOD
Remove Device
Expert Mode:
Ok
Cancel

Double-click on a Device to open it
Click on a Device to select it
Click on a data field to edit it

Node Type: Local MxView

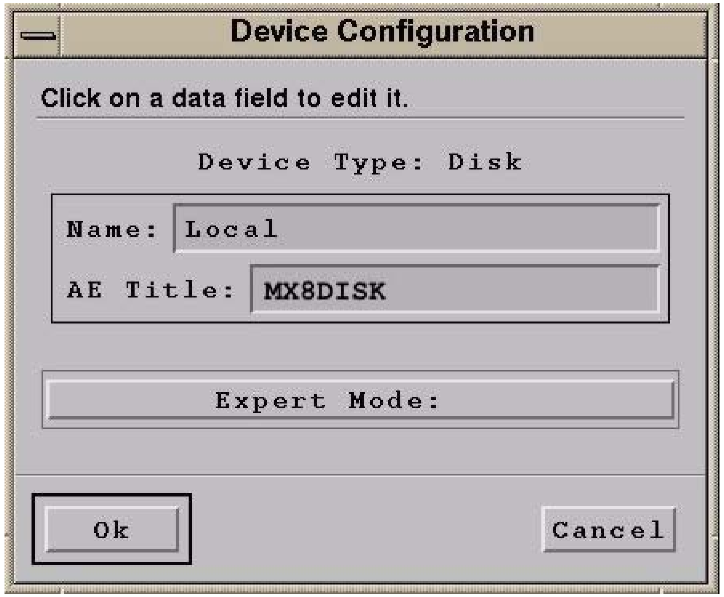
Name: MX8

IP: 62.0.62.96

Existing Devices:

Local
Memory
Temp-disk
Demo
StorageCommitment

Figure 8-3: Node Configuration Dialog Box


Device Configuration
Expert Mode:
Ok
Cancel

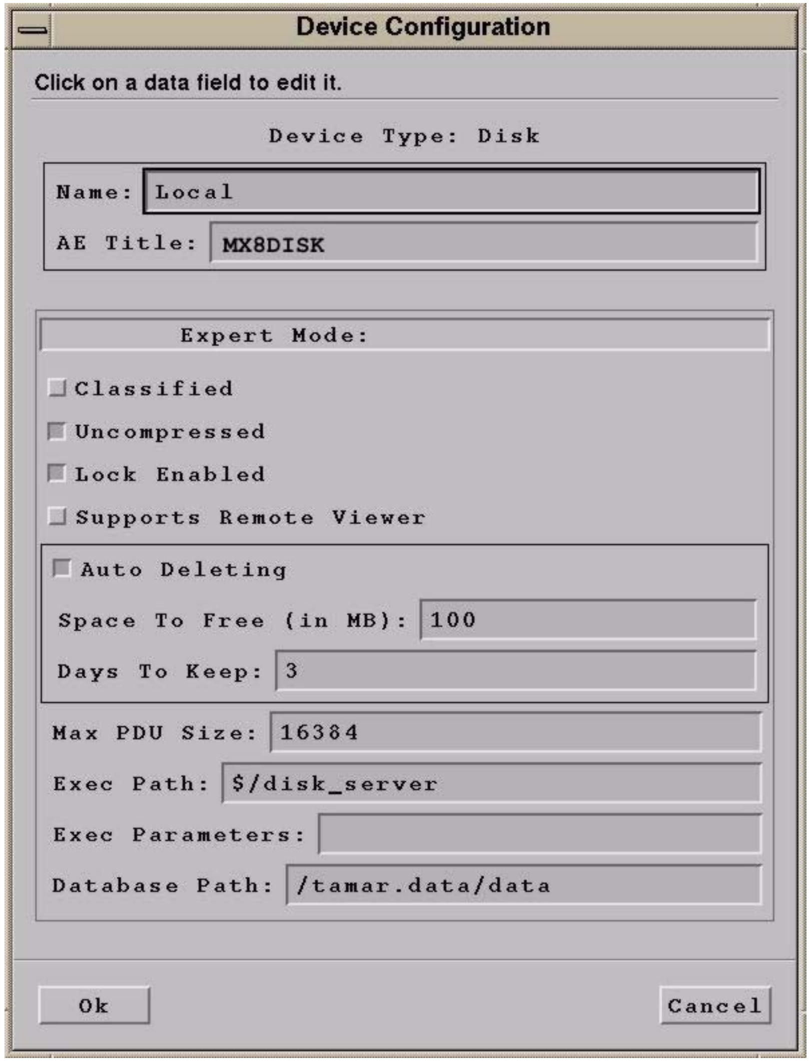
Click on a data field to edit it.

Device Type: Disk

Name: Local

AE Title: MX8DISK

Figure 8-4: Node Configuration Dialog Box for the Local Disk


Device Configuration
Click on a data field to edit it.
Ok
Cancel

Device Type: Disk

Name: Local

AE Title: MX8DISK

Expert Mode:

☐ Classified

☑ Uncompressed

☑ Lock Enabled

☐ Supports Remote Viewer

☑ Auto Deleting

Space To Free (in MB): 100

Days To Keep: 3

Max PDU Size: 16384

Exec Path: $/disk_server

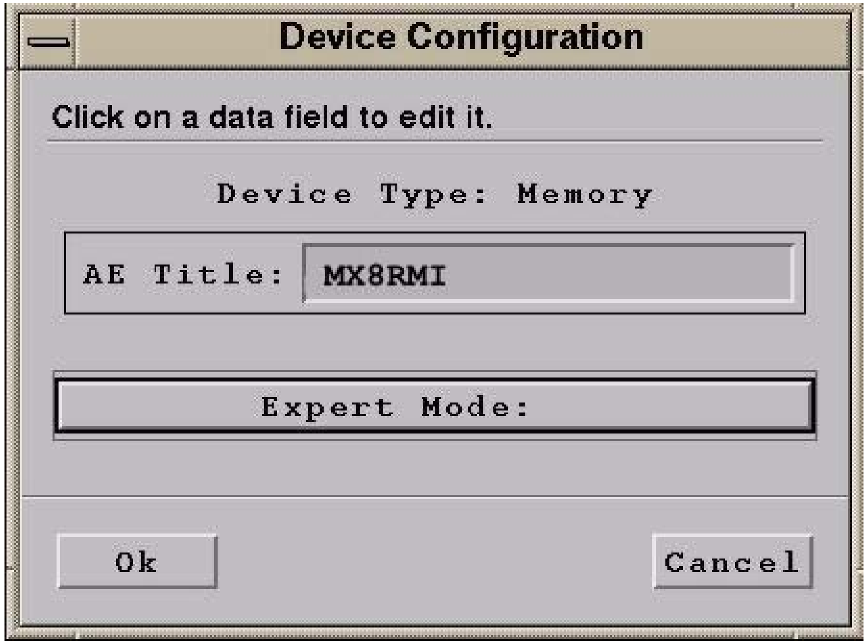
Exec Parameters:

Database Path: /tamar.data/data

Figure 8-5: Device Configuration Dialog Box for Local Disk in Expert Mode

NOTE:

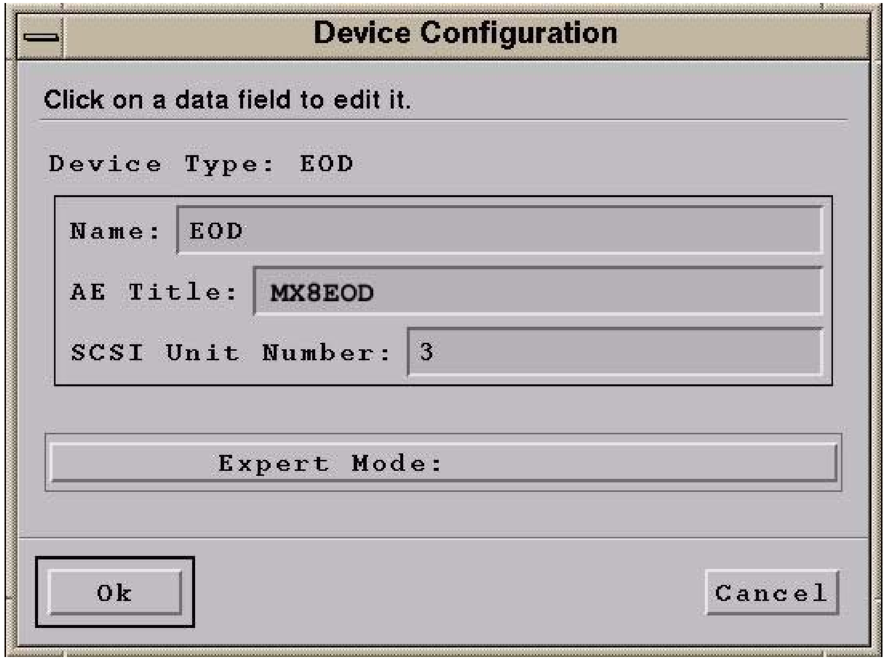
If the Remote Viewer option is available, click **Supports Remote Viewer**.


Device Configuration
Click on a data field to edit it.
Expert Mode:
Ok
Cancel

Device Type: Memory

AE Title: MX8RMI

Figure 8-6: Device Configuration Dialog Box for Memory



Click on a data field to edit it.

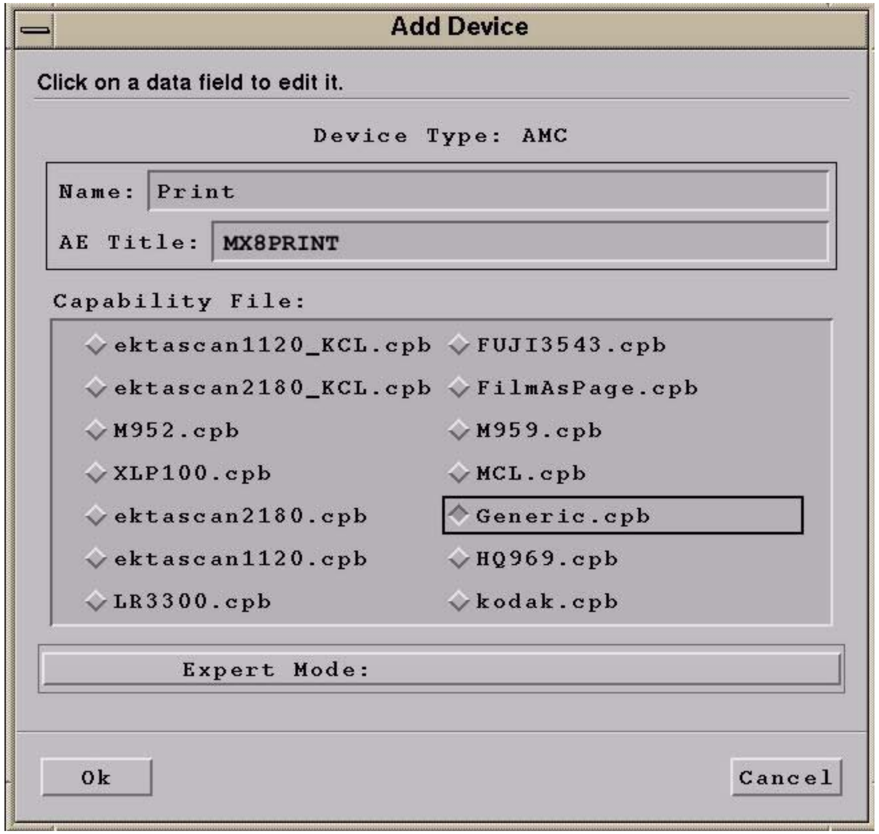
Device Type: EOD

Name: EOD

AE Title: MX8EOD

SCSI Unit Number: 3

Figure 8-7: Device Configuration Dialog Box for EOD



Click on a data field to edit it.

Device Type: AMC

Name: Print

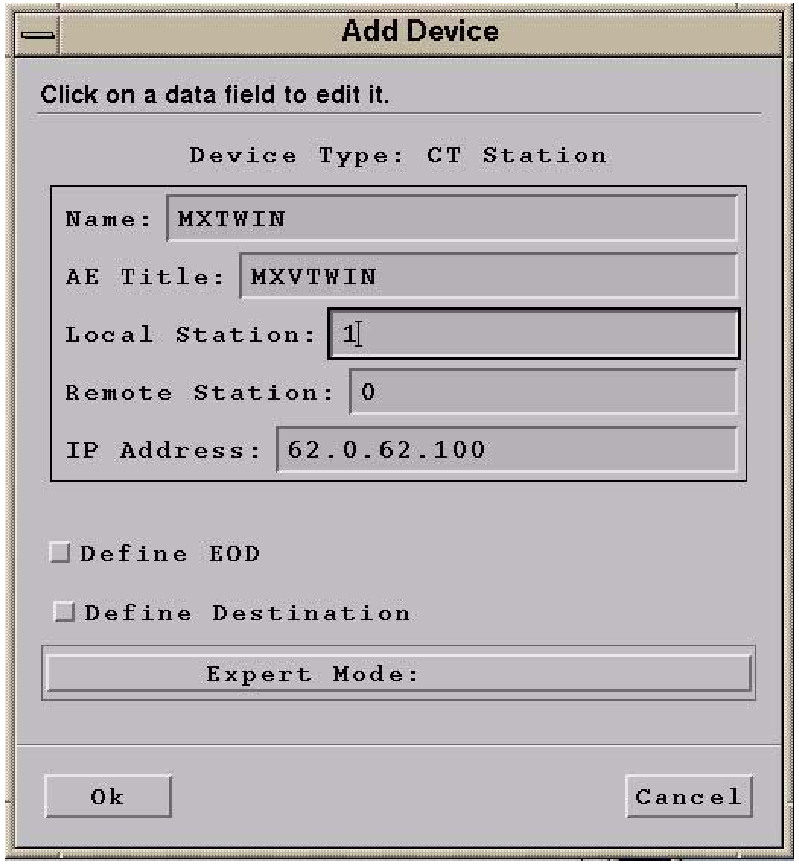
AE Title: MX8PRINT

Capability File:

◇ ektascan1120_KCL.cpb	◇ FUJI3543.cpb
◇ ektascan2180_KCL.cpb	◇ FilmAsPage.cpb
◇ M952.cpb	◇ M959.cpb
◇ XLP100.cpb	◇ MCL.cpb
◇ ektascan2180.cpb	◇ Generic.cpb
◇ ektascan1120.cpb	◇ HQ969.cpb
◇ LR3300.cpb	◇ kodak.cpb

Figure 8-8: Device Configuration Dialog Box for AMC

Choose the Capability file that matches your printer. If the printer does not appear in the list, choose Generic.cpb.
FilmAsPage allows you to work from MasterFilm in any format without having to match the format on the keypad. The keypad format must be 1:1.



Add Device

Click on a data field to edit it.

Device Type: CT Station

Name: MXTWIN

AE Title: MXVTWIN

Local Station: 1

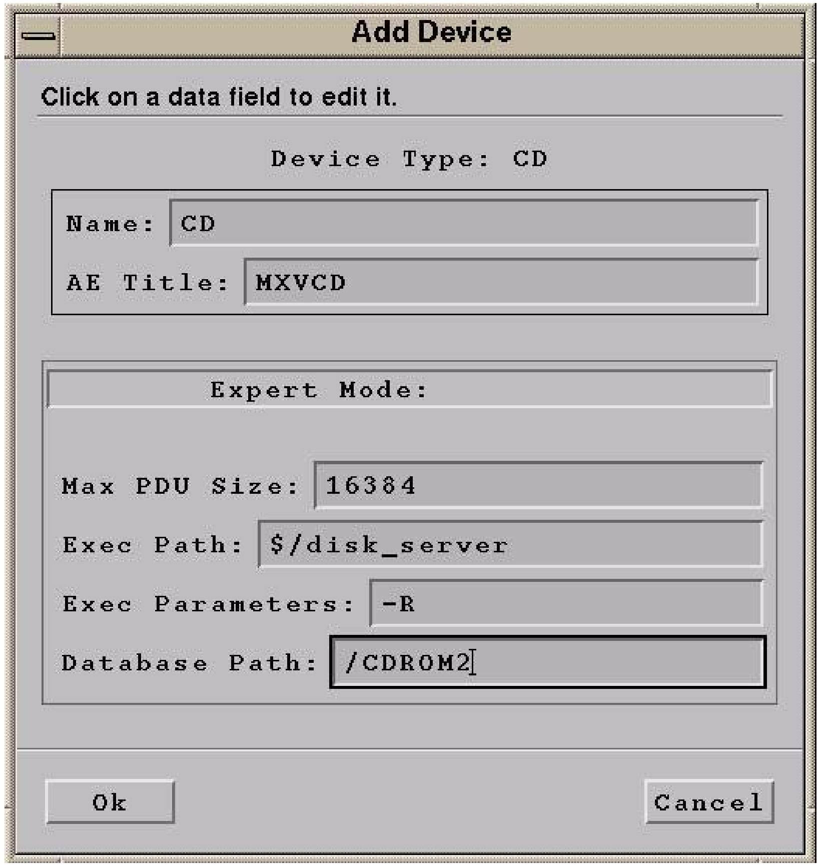
Remote Station: 0

IP Address: 62.0.62.100

☐ Define EOD

☐ Define Destination

Figure 8-9: Device Configuration Dialog Box for Mx8000 Connection to MxTwin Scanner



Add Device

Click on a data field to edit it.

Device Type: CD

Name: CD

AE Title: MXVCD

Expert Mode:

Max PDU Size: 16384

Exec Path: $/disk_server

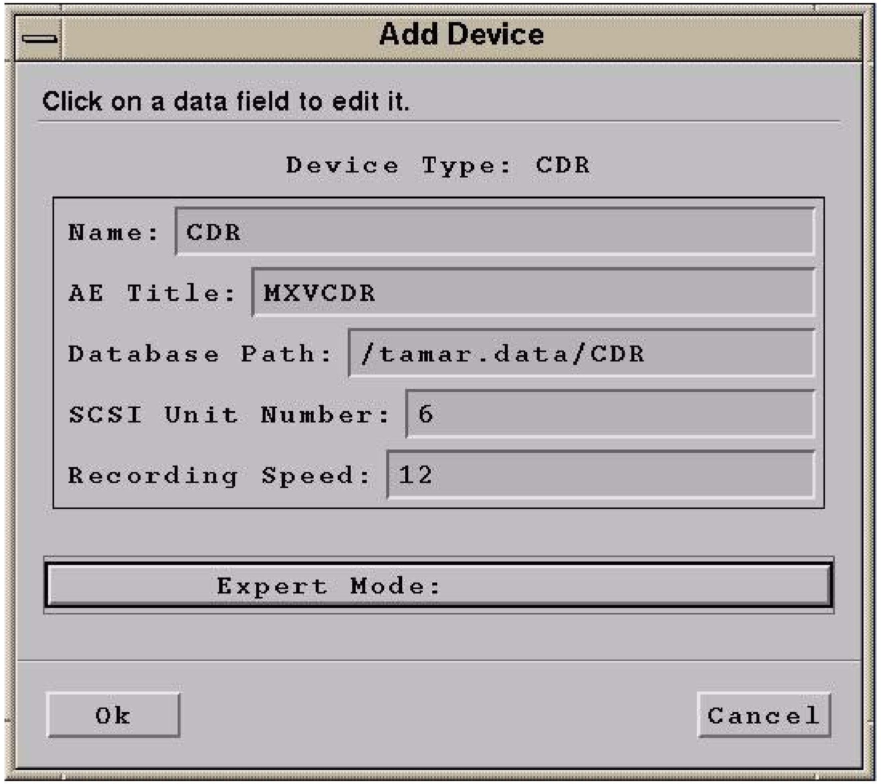
Exec Parameters: -R

Database Path: /CDROM2

Figure 8-10: Device Configuration Dialog Box for CD

NOTE:

If the system recognizes the internal CD-ROM as "CD-ROM", you must change the path to "/CDROM2".


Add Device
Click on a data field to edit it.
Expert Mode:
Ok
Cancel

Device Type: CDR

Name: CDR

AE Title: MXVCDR

Database Path: /tamar.data/CDR

SCSI Unit Number: 6

Recording Speed: 12

Figure 8-11: Device Configuration Dialog Box for CDR-R

NOTE:

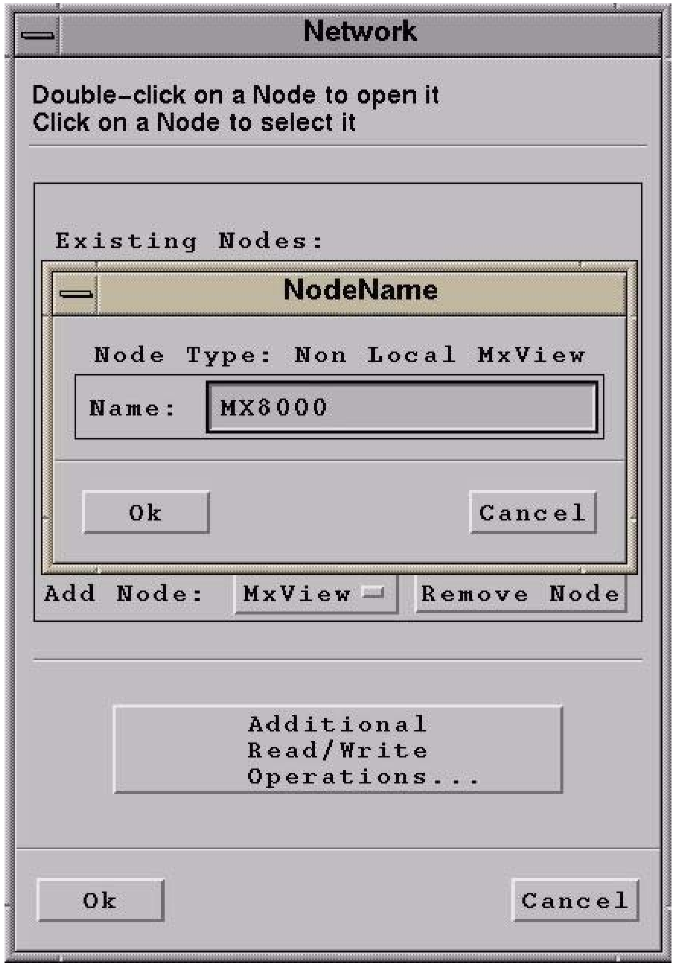
Change the recording speed if:

- Your CD-R media does not support 12x recording speed
- Your CD-R drive does not support 12x recording speed

Use the highest speed common to both.

Remote Mx8000 Devices

Disk	The hard disk of the Mx8000
Memory	The memory of the Mx8000
EOD	Erasable Optical Disk
AMC	A laser imager which is connected through an AMC box
CT Station	A MxTWIN scanner or OmniView/GVS workstation
Export	Used to export images to files
Folder	Hard disk folder


Network

Double-click on a Node to open it
Click on a Node to select it

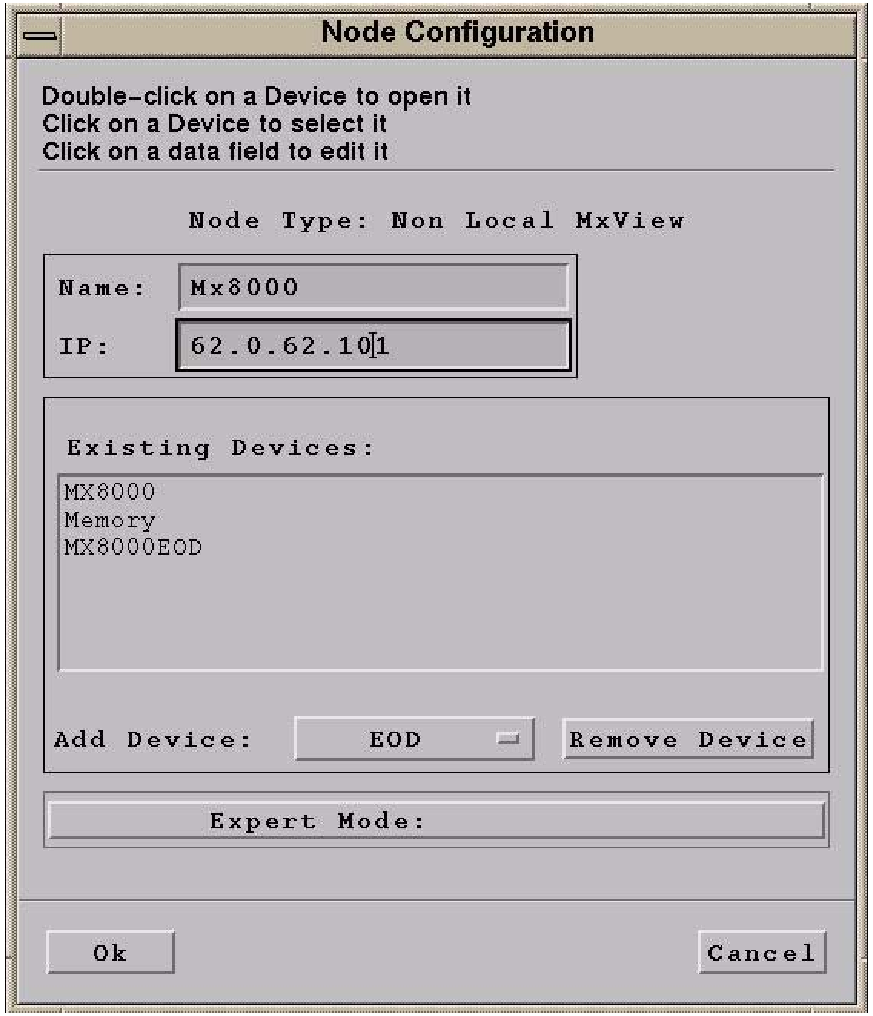
Existing Nodes:
NodeName

Node Type: Non Local MxView

Name: MX8000

Ok
Cancel
Add Node:
MxView
Remove Node
Additional Read/Write Operations...
Ok
Cancel

Figure 8-12:


Node Configuration
Remove Device
Expert Mode:
Ok
Cancel

Double-click on a Device to open it
Click on a Device to select it
Click on a data field to edit it

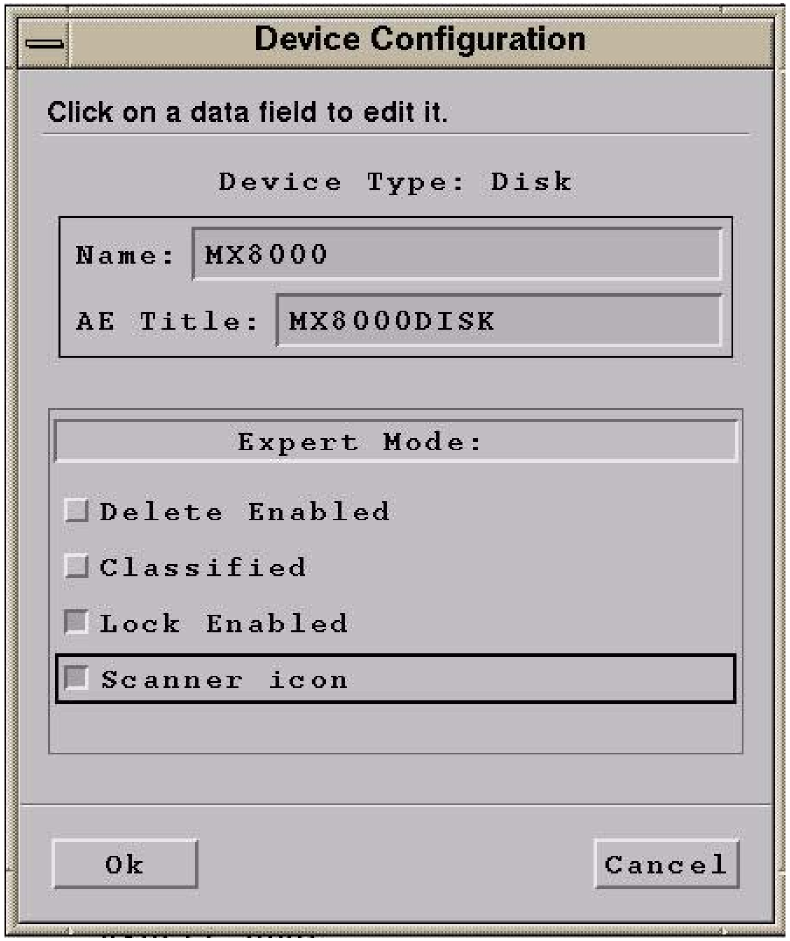
Node Type: Non Local MxView

Name: Mx8000
IP: 62.0.62.101

Existing Devices:
MX8000
Memory
MX8000EOD

Add Device: EOD

Figure 8-13: Node Configuration Dialog Box


Device Configuration
Expert Mode:
Ok
Cancel

Click on a data field to edit it.

Device Type: Disk

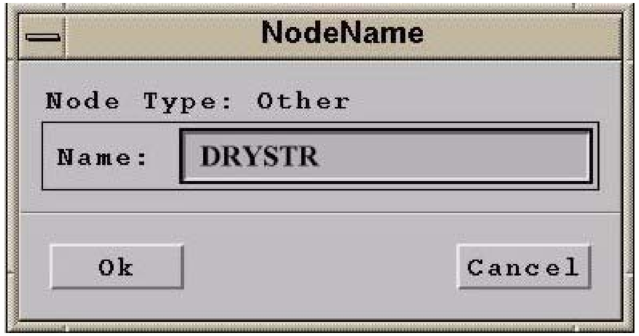
Name: MX8000
AE Title: MX8000DISK

☐ Delete Enabled
☐ Classified
☑ Lock Enabled
☑ Scanner icon

Figure 8-14: Device Configuration Dialog Box for Local Disk in Expert mode with Scanner Icon Enabled

Other DICOM (non-MxView) Devices:

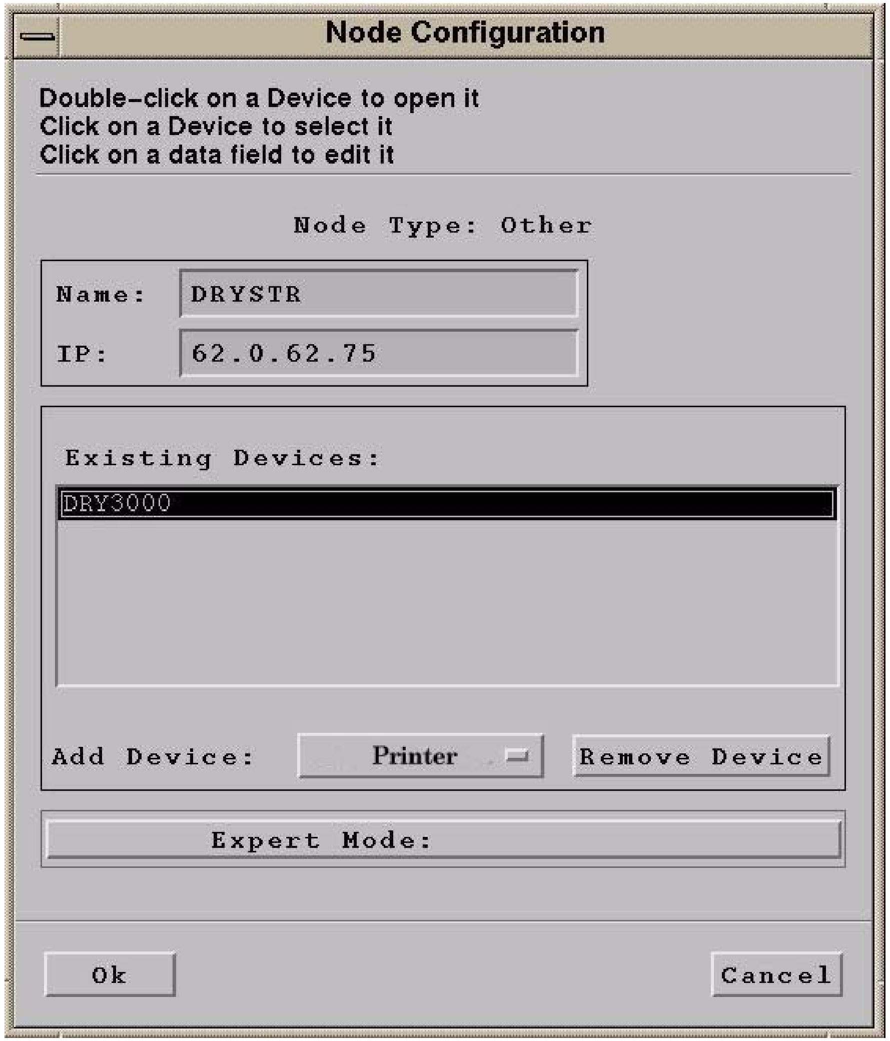
- Storage A foreign DICOM storage device (a scanner, workstation, PACS etc.)
- Printer A foreign DICOM printer or laser imager
- HIS/RIS A foreign Hospital Information System/Radiology Information System
- Commitment DICOMStorage Commitment server
- SiteManager



Node Type: Other

Name: DRYSTR

Figure 8-15: Adding a Foreign Node—DICOM Printer



Double-click on a Device to open it
Click on a Device to select it
Click on a data field to edit it

Node Type: Other

Name: DRYSTR

IP: 62.0.62.75

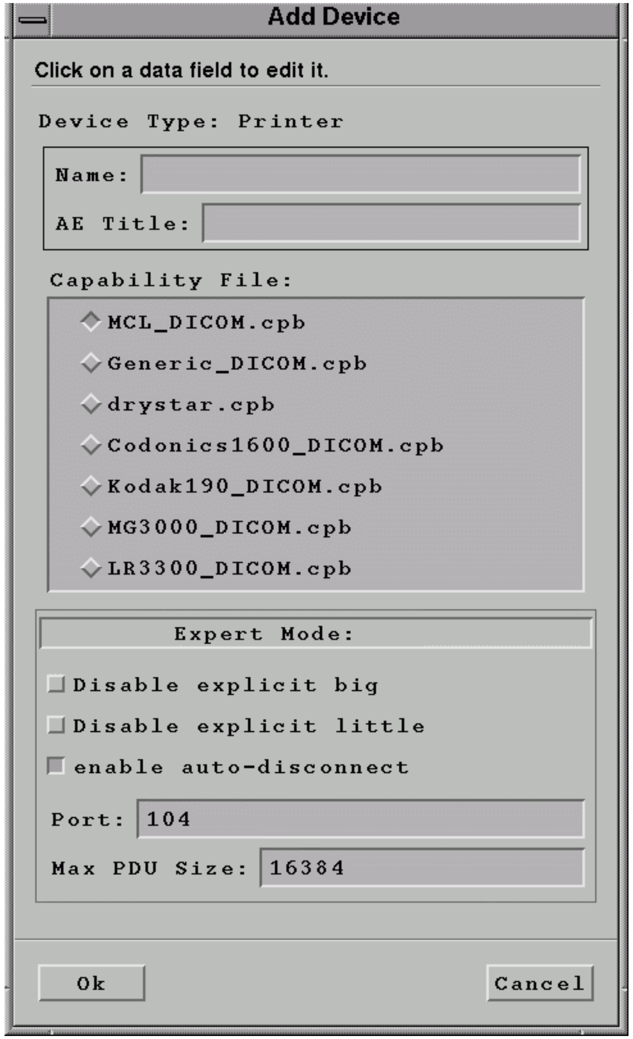
Existing Devices:

DRY3000

Add Device: Printer

Figure 8-16: Node Configuration Dialog Box—DICOM Printer

Printer



Click on a data field to edit it.

Device Type: Printer

Name:

AE Title:

Capability File:

- ○ MCL_DICOM.cpb
- ○ Generic_DICOM.cpb
- ○ drystar.cpb
- ○ Codonics1600_DICOM.cpb
- ○ Kodak190_DICOM.cpb
- ○ MG3000_DICOM.cpb
- ○ LR3300_DICOM.cpb

Expert Mode:

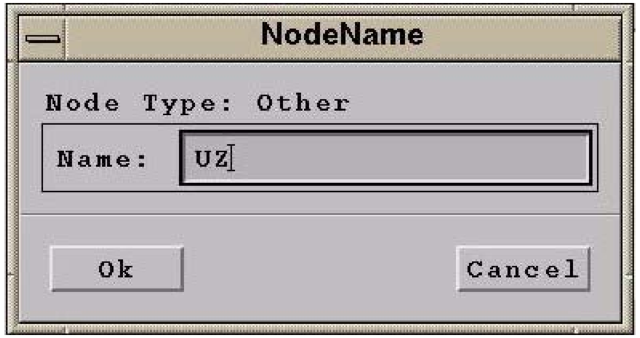
- ☐ Disable explicit big
- ☐ Disable explicit little
- ☐ enable auto-disconnect

Port: 104

Max PDU Size: 16384

Figure 8-17: Printer Device Configuration

Choose the Capability file that matches your printer. If the printer does not appear in the list, choose Generic_DICOM.cpb.



Node Type: Other

Name: UZ

Figure 8-18: Adding a Foreign Node—Ultra

Adding HIS/RIS to the Mx8000

Operation

Mx8000 version 2.0 and later supports the HIS/RIS systems using the following two DICOM services:

- Modality Worklist Management—used to get patient demographic data into the Patient Data screen from the HIS/RIS without the need to enter the data manually.
- Modality Performed Procedure Step (MMPS)—used to notify the system about each study. The scanner sends notification when a new study is started and when it is completed, including the list of image instances acquired during this study.

Getting the Worklist from HIS/RIS

If a DICOM HIS/RIS Host Modality Worklist Service is defined, then a special HIS/RIS icon is displayed on the patient data screen. This icon is used to retrieve the worklist (i.e. the list of scheduled procedures) for this scanner.

The HIS/RIS icon can be used in two ways:

A. If a study is started and no fields in the Patient Data screen are filled in yet, clicking **HIS/RIS** retrieves the whole worklist for this scanner. The query can be limited (filtered) by clicking **Lastdays** or **Filter** and entering the filter criteria, e.g., a number of days.

B. If after starting a new study, the operator fills in some of the fields in Patient Data, (e.g., first few letters of the patient's name, ID, accession number) and then clicks HIS/RIS, the entered fields serve as a filter for HIS/RIS query. Only the matching scheduled procedures are returned in the worklist.

As a result of the HIS/RIS query, the list of all the found scheduled procedures is displayed and the operator selects one of them to be the current study. All the demographic data and other study information is automatically copied to the Patient Data fields.

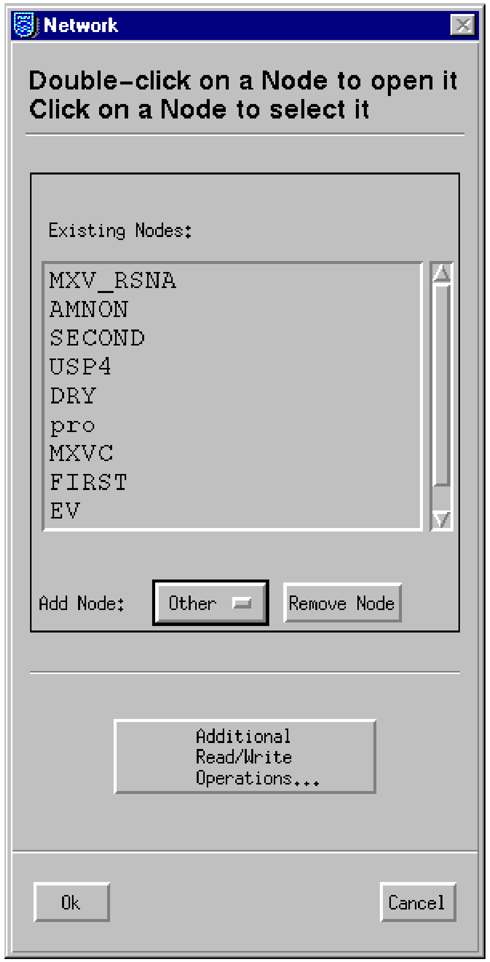
MPPS Operation

MMPS is done automatically, without the operator's involvement.

Configuration Instructions

Define HIS/RIS DICOM Host

1. Click **Other** to add a host (see *Figure 8-19*).
2. On the new host, click **HIS/RIS** to add an HIS/RIS device (see *Figure 8-20*).

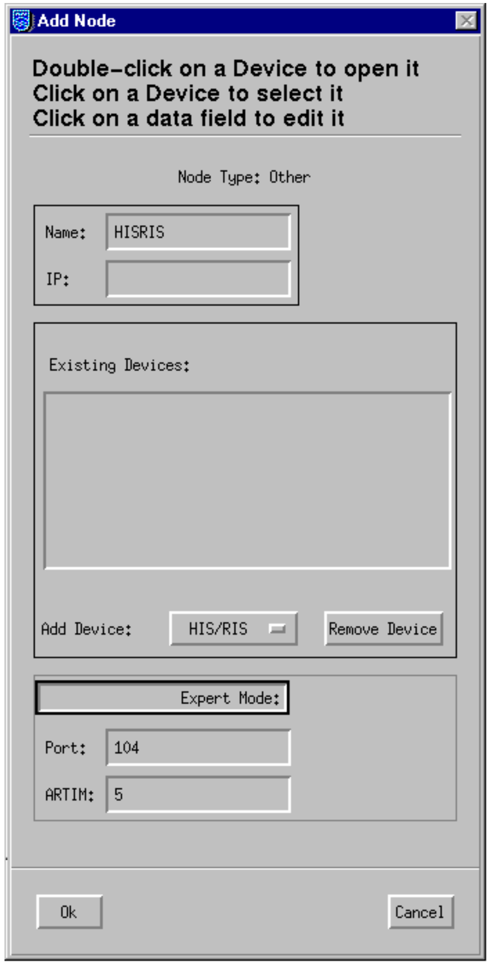

Network
Remove Node
Additional Read/Write Operations...
Ok
Cancel

Double-click on a Node to open it
Click on a Node to select it

Existing Nodes:
MXV_RSNA
AMNON
SECOND
USP4
DRY
pro
MXVC
FIRST
EV

Add Node: Other

Figure 8-19:


Add Node
Existing Devices:
Remove Device
Ok
Cancel

Double-click on a Device to open it
Click on a Device to select it
Click on a data field to edit it

Node Type: Other

Name: HISRIS
IP:

Add Device: HIS/RIS

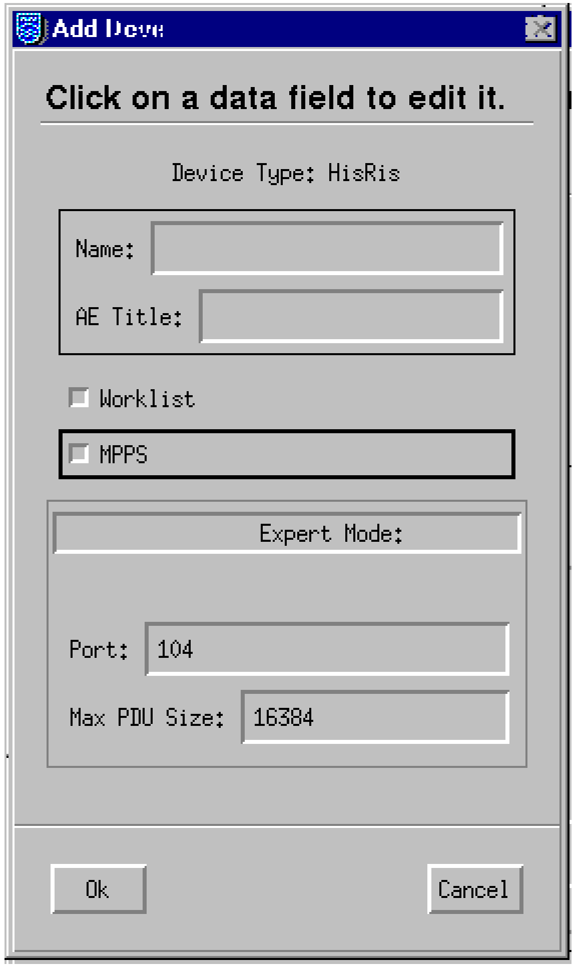
Expert Mode:
Port: 104
ARTIM: 5

Figure 8-20:

3. Define the name and AE title for this device (see *Figure 8-21*).
4. Check the required service: **Worklist** and **MMPS**.
5. If you are working in Expert mode, define the port number (default 104).
6. Save the changes and exit.

NOTE:

The HIS/RIS system is to be configured by the site network administrator or by the HIS/RIS vendor representative.



Click on a data field to edit it.

Device Type: HisRis

Name:

AE Title:

☐ Worklist

☐ MPPS

Expert Mode:

Port: 104

Max PDU Size: 16384

Figure 8-21:

Site Manager

Overview

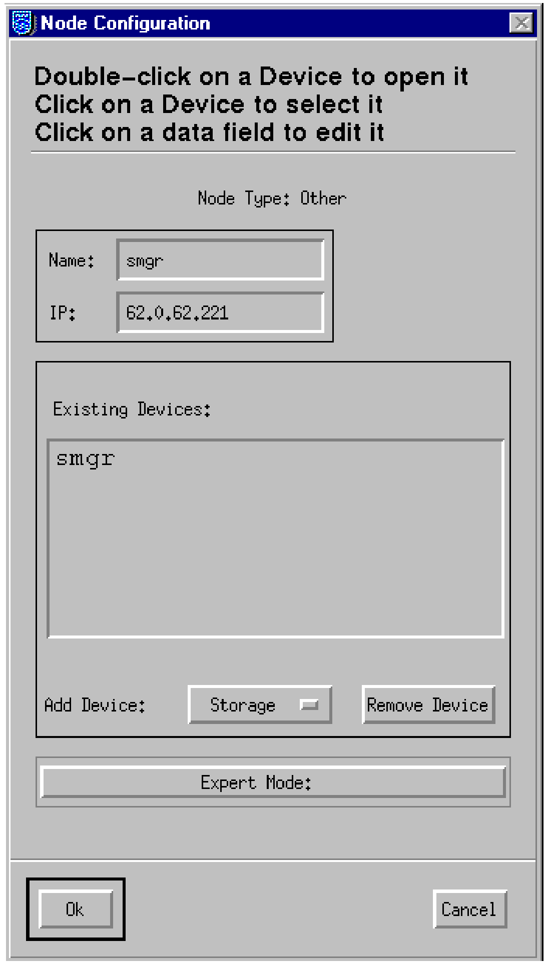
The SiteManager Server is an ethernet/modem based remote access server that provides terminal service and IP routing over dial-up lines. Working in conjunction with Servecom and a centrally located server, the SiteManager enables dial-up internet working with remote Philips equipment.

The SiteManager has a modem and an ethernet card to start a PPP connection to the LAN. It contains a FTP utility for transferring important files to the local PC. It is also able to poll the scanners and record important site information, store all diagnostics, view log files, and has an easy-to-use interface to all diagnostic routines.

Configuring the Mx8000 to Recognize the SiteManager

Configure the SiteManager as an other node, to receive images for remote viewing, as follows:

1. In the Network Configuration dialog box (see *Figure 8-2*), click **Other**, and then click **OK**. The Node Configuration dialog box appears (see *Figure 8-22*).
2. Enter **smgr** in the Name text box. In the IP text box, enter the the local SiteManager IP address and click **OK**. The Device Configuration dialog box appears.


Node Configuration

Double-click on a Device to open it
Click on a Device to select it
Click on a data field to edit it

Node Type: Other

Name: smgr

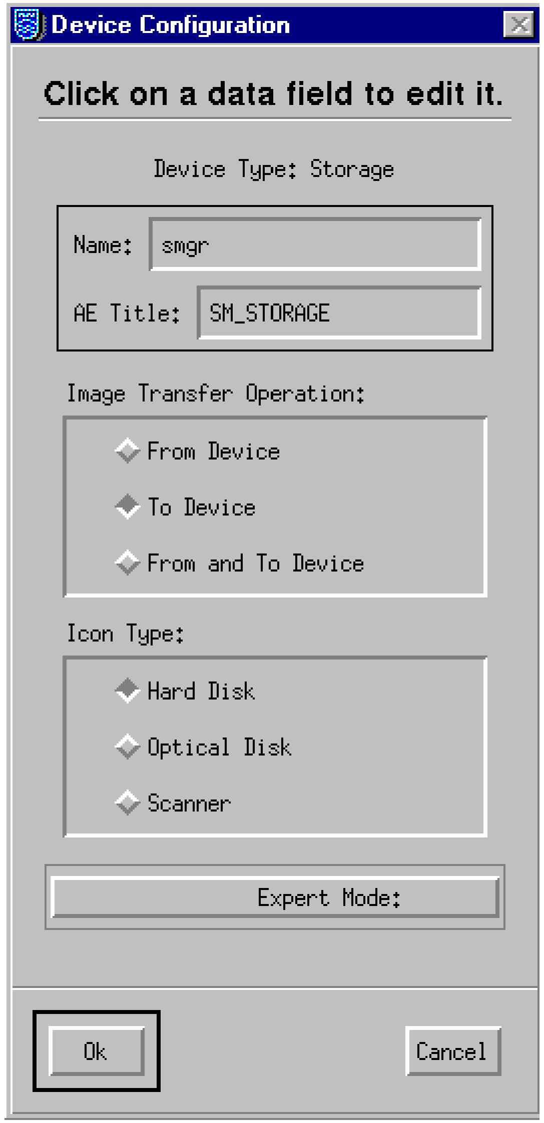
IP: 62.0.62.221

Existing Devices:

smgr

Figure 8-22: Node Configuration Dialog Box

3. In the Device Configuration dialog box (see *Figure 8-23*), enter **SM_STORAGE** in the AE Title text box. In the Image Transfer Operation frame, check the **To Device** option and click **OK**.
4. Restart the computer or configure another device/node.


Device Configuration
Click on a data field to edit it.

Device Type: Storage

Name: smgr

AE Title: SM_STORAGE

Image Transfer Operation:

◇ From Device
◆ To Device
◇ From and To Device

Icon Type:

◆ Hard Disk
◇ Optical Disk
◇ Scanner

Expert Mode:
Ok
Cancel

Figure 8-23: Device Configuration Dialog Box

Configuring the SiteManager to Recognize the Mx8000

To configure the SiteManager to receive images from the Mx8000, refer to the SiteManager documentation.

NOTE:

Ensure that the AE Title in the SiteManager’s configuration utility is set to **proDISK**.

Device Configuration

This section describes the fields in the **Device Configuration** dialog box for different devices.

General Device Fields

Basic fields

NAME

Description:	The name of the device as displayed to the user (in the Archive Manager and in the applications)
Syntax:	1-10 characters. Each character is either a letter, a digit, a minus sign (-) or an underscore (_).

AE TITLE

Description: The Application Entity Title of the device. This is the address of the device as defined in DICOM. The AE Title is a unique name for each device on the same network (two devices are not allowed to have the same AE Title). It is recommended to change the beginning of the AE titles to logical names such as MX8 or MXV. For example, change ProDISK to MXVDISK.

> **NOTE:**
>
> When you change the Name of the local Mx8000, the change effects all the local clients, excluding the Memory (MXVRMI), Tempdisk, and storage commitment.
>
> All local clients can have the same AE-Title (e.g., MXV), excluding the Memory (MXVRMI), Tempdisk, and storage commitment.
>
> It is recommended to use capital letters (upper case) when filling-in the AE Title fields.

It is generally easier to isolate a problem when the AE title is defined as recommended above.

Syntax: 1-16 characters

Local Disk Device Fields
Basic Fields

CLASSIFICATION

Description:	Feature that displays the Archive in classified mode

LOCK ENABLE

Description:	Enables erasure protection of a specific patient or patients from the archive

SUPPORT REMOTE VIEWER

Description:	Enables the Remote Viewer/Remote Monitor option

AUTO DELETING

Description:	Enables Auto Delete of files from the archive.
Syntax:	Space to free (in MB) and days to keep

MAX PDU SIZE
(PROTOCOL DATA UNIT)

Description:	The maximal size of a PDU which is used by the device for DICOM communication.
Syntax:	A positive integer

EXEC PATH

Description:	The name of the program to be executed
Syntax:	A name of a file (including a full path)

Local Disk Device Fields
Basic Fields (Continued)

EXEC PARAMETERS

Description:	Additional parameters
Syntax:	Device dependant

DATABASE PATH

Description:	The full path of the database which is used by the device
Syntax:	A name of a directory (including a full path)

Local Disk Device Fields
Expert Mode

CLASSIFICATION

Syntax	First letter—given name, second letter—family name

UNCOMPRESSED

Description:	Normal position is compressed Dicom. Uncompressed enables the files to be saves on the disk/EOD without compression.

LOCK ENABLE

Description:	Enables erasure protection of a specific patient or patients from the archive

SUPPORT REMOTE VIEWER

Description:	Enables the Remote Viewer/Remote Monitor option

AUTO DELETING

Description:	Enables Auto Delete of files from the archive.
Syntax:	Space to free (in MB) and days to keep

MAX PDU SIZE
(PROTOCOL DATA UNIT)

Description:	The maximal size of a PDU which is used by the device for DICOM communication.
Syntax:	A positive integer

EXEC PATH

Description:	The name of the program to be executed
Syntax:	A name of a file (including a full path)

Local Disk Device Fields
Expert Mode (Continued)

EXEC PARAMETERS

Description:	Additional parameters
Syntax:	Device dependant

DATABASE PATH

Description:	The full path of the database which is used by the device
Syntax:	A name of a directory (including a full path)

Field for Folder Devices

The same fields as for local disk: Database Path should be defined.

Field for EOD DEvice

The same fields as for local disk and the following additional field in expert mode:

SCSI UNIT NUMBER

Description:	SCSI device (unit ID) number

Fields for MxTwin CT Station Devices

LOCAL STATION	
Description:	The number of the local station (the MxView) in the CT_LAN configuration files
Syntax:	A single digit between 0 to 4
REMOTE STATION	
Description:	The number of the remote station (the scanner or the OmniView) in the CT_LAN configuration files
Syntax:	A single digit between 0 to 4
IP ADDRESS	
Description:	The internet address of the remote station (the scanner or the OmniView)
Syntax:	x.y.z.w where x,y,z,w are decimal numbers between 0 and 255
DEFINE EOD TOGGLE	
Description:	This toggle is used to specify if the remote station (scanner or OmniView) has an EOD device
DEFINE EOD NAME	(Only when define EOD toggle is on)
Description:	The name of the EOD device as displayed to the user (in the Archive Manager and in the applications)
Syntax:	1-10 characters. Each character is either a letter, a digit, a minus sign (-) or an underscore (_)
EOD AE TITLE	(Only when define EOD toggle is on)
Description:	The Application Entity Title of the EOD device. This is the address of the device as defined in DICOM. The AE Title must be unique for each device (two devices are not allowed to have the same AE Title).
Syntax:	1-16 characters

Fields for AMC Devices
Basic Fields

CAPABILITY FIELD

Description:	The name of the file which describes the capabilities of the printer or the laser imager. One of a given set of known printer types.

Fields for Export Devices
Basic Fields

DESTINATION DIRECTION

Description:	The name of the directory to which the images are exported
Syntax	A full directory (path) name

TRANSFER SYNTAX

Description:	The DICOM Transfer Syntax in which the exported files should be written. One of a given set of possibilities (as defined in DICOM)

METAFILE

Description:	Export in standard DICOM Part-10 file

Fields for Export Devices
Expert Fields

CONVERSION PROGRAM

Description:	The program which converts the exported files to another format (a non-DICOM format)
Syntax	A name of a file (including a full path)

CONVERSION PARAMETERS

Description:	Parameters of the conversion program
Syntax	Depends on the conversion program

Fields for Import Devices

INPUT DIRECTORY

Description:	The name of the directory from which the images are imported
Syntax	A full directory (path) name

TARGET DEVICE

Description:	Name of the device (e.g., Local, folders, Eod, Remote) where the imported images are transferred to

INPUT FORMAT

Description:	The DICOM Transfer Syntax in which the files are expected. One of a given set of possibilities (as defined in DICOM), or standard DICOM Part-10 Files.

Fields For CD-R Device

DATABASE PATH

Description	The full path of the database which is used by the device
Syntax	A name of a directory (including a full path)

SCSI UNIT NUMBER

Description	SCSI device (unit ID) number

RECORDING SPEED

Description	Maximum recording speed (depending on drive type and media), e.g., 12

Remote Mx8000/MxView Disk Fields

DELETE ENABLED

Description	Whether delete on remote MxView disk is enabled

SCANNER ICON

Description	Assign scanner icon for this device (e.g., for Mx8000 scanner)

Fields For An Arbitrary DICOM Storage Device
Basic Fields:

IMAGE TRANSFER OPERATION

Description	Determines which of the following operations are performed: - *From Device*: Transferring images from the device to the MxView (Icon of the device is added to the Archive Manager). - *To Device*: Transferring images from the MxView to the device (No Icon is added to the Archive Manager). - *To/From device:*Transferring images in both directions (Icon of the device is added to the Archive Manager).

ICON TYPE

Description	The type of icon which is displayed in the Archive manager. One of a given set of icons. (currently there are 3 icons: Hard Disk, Optical Disk and Scanner).

The following field appears only in Expert Mode

PORT

Description	The number of the port which is used by the device for DICOM communication. By default, it is the Port number defined in the node parameters. If this parameter is changed, it overrides the value which is defined for the node.

DISABLE TRANSFER SYNTAXES

Description	Remove Explicit Big Endian and Explicit Little Endian from proposed list of transfer syntaxes during association establishment.

SUPPORT OVERLAYS

Description	Assumes that this system supports DICOM overlays (group 60xx). If disabled (unchecked), the overlays are burned-in. Applicable only to Secondary Capture images (e.g., Save Display).

ICONIMAGE

Description	Assumes that this system supports icon sequence. If disabled (unchecked), the icon sequence (0088,0200) is removed from the image.

STORAGECOMMITMENT

Description	If defined, the storage commitment request is issued for each image sent to this station.

STORAGECOMMITMENT AE TITLE

Description	If defined, the AE title of the storage commitment device. Otherwise, the same AE Title as the storage device.

Fields For An Arbitrary DICOM Printer Device
Basic Fields:

CAPABILITY FILE

Description	The name of the file which describes the capabilities of the printer or the laser imager. One of a given set of known printer types.

The following Field appears only in expert mode

PORT

Description	The port number which is used by the device for DICOM communication. The default is the DICOM standard port (104).

Mx8000 Workstation Export Function

The Mx8000 Export function enables the user to export images in DICOM format from the Mx8000 archives. Images can be exported to the Mx8000 hard disk, floppy diskette, EOD cartridge or to a DICOM station (a station that accepts the DICOM format).

The exported images can be stored in a special directory on the local disk, and then copied to any media, or to a DICOM station through a network.

The copying procedure to a floppy or a DICOM station is performed by opening a Unix shell, and not through the Archive Manager (see *"Exporting Images to a Floppy, or a DICOM Station"*).

Images can be exported directly to an EOD cartridge. Copying images to the EOD can be performed also through the Archive Manager if the system is configured properly.

Creating an Export Device (Configuration)

To create an export device on the hard disk:

1. From the **Configuration** application click on the local node.
2. From the **Add Device** list, click **Export**. The **Device Configuration** window opens.
3. In the **Name** field, type in the name for the Export device, or use the default value.
4. In the **AE Title** field, type in the Application Entity Title for the device, or use the default value.
5. In the **Destination Directory** field, type the directory where you want the images to be stored. To use the default directory (recommended), type: **/usr/tmp/export** and press **<Enter>**.

NOTE:

For instructions on how to create a directory (see *Step 8* below).

6. From the **Transfer Syntax** list, choose the desired format. For details see *"Transfer Syntax"*.
7. Click **OK** several times to exit, and then confirm to reboot.

8. Create the destination directory as follows:
    a. Login as **root**, and open a Unix shell.
    b. Type: **mkdir /usr/tmp/export** and press **<Enter>**.
    c. To verify that the directory you created exists type: **ls /usr/tmp**, press **<Enter>** and check the directory name is listed.
    d. Log out and then log in as **Mx8000**.

To create an export device directly on the EOD:

1. From the **Configuration** application click on the local node.
2. From the **Add Device** list, click on **Export**. The **Device Configuration** window opens.
3. In the **Name** field, type in the name for the export device, or use the default value.
4. In the **AE Title** field, type in the Application Entity Title for the device, or use the default value.
5. In the **Destination Directory** field, type: **/EOD/3** and press **<Enter>.**
   If your system has a second EOD device, type **4** instead of **3** in the line above.)
6. From the **Transfer Syntax** list, choose the desired format. For details see *"Transfer Syntax"*.
7. Click **OK** several times to exit, and then confirm to reboot.

Exporting Images to a Floppy, or a DICOM Station

Exporting images requires two steps:

1. Exporting the images to the hard disk.
2. Copying the images from the hard disk to a floppy or a DICOM station.

Exporting Images to the Hard Disk

Export images to the hard disk in one of the following ways:

- From the Archive Manager, use **Copy** and specify the Export Device as the destination.
- From any application other than Archive Manager, use **Save** and specify the Export Device as the destination.

The exported images are stored in the destination directory. Files can be identified by the Patient Name and copied to a floppy or a DICOM station.

Copying Images from the Hard Disk to a Floppy or to a DICOM Station

A. Copy images from the hard disk to a floppy, as follows:

1. Open a winterm (use password: **letmein**).
2. Insert a formatted floppy diskette into the floppy drive. Wait a few seconds, until the floppy is mounted.
3. Type: **cd /usr/tmp/export** and press **<Enter>**.
4. Type: **cp <image name> /floppy/<x>** and press **<Enter>**.

   <x> is a DOS file name containing up to eight characters for the file name, and up to three characters for the extension.
5. After you have finished copying all images, you can delete the images from the export directory to free disk space.
6. To delete the images, type in the winterm: **rm -f *** and press **<Enter>**.

B. Copy images from the hard disk to a DICOM station, as follows:

1. Open a winterm (use password: **letmein**).
2. Type: **cd /usr/tmp/export** and press **<Enter>**.
3. Use FTP to connect to the DICOM station. Type: **ftp <Station IP>** and press **<Enter>**.

<Station IP> is the IP address of the DICOM station.

4. When prompted for a user name or login name, type the name you received from the hospital Network Administrator.
5. When prompted for a password, type the password you received from the hospital Network Administrator.
6. Copy each image you want to transfer by typing: **put <image name> <new image name>** and pressing **<Enter>**. (**<new image name>** is optional. Use it if you want to change the file name.)
7. When you are done, quit FTP by typing: **bye** and pressing **<Enter>**
8. After you have finished copying all images, you may delete the images from the export directory to free disk space. To delete the images, type in the winterm:
9. **rm -f *** and press **<Enter>**

Exporting images Directly to the EOD

You must follow the instructions below exactly as written:

1. Insert a formatted cartridge into the EOD drive.
2. Click on the local EOD device icon in the Archive Manager to select it.

NOTE:

Do not try to export images if the EOD device fails to open.

3. To export, do one of the following:
   - — From the Archive Manager, click **Copy** and specify the export device as the destination.
   - — From any application other than Archive Manager**,** click **Save** and specify the export device as the destination.

4. After you have finished exporting all images (check by viewing the Queue Manager), eject the cartridge using the **Eject** option from the **Archive Manager**.

Transfer Syntax

When DICOM devices communicate, they agree on possible formats for image transfer. In particular, they agree on whether the images are transferred in implicit or explicit value representation, and whether words are encoded in little or big endian. When accessing a floppy or an EOD cartridge, the format of the images has to be pre-defined.

Choose the format for image transfer according to the system that reads the images from the EOD/floppy. Get the format from the hospital Network Administrator.

The three following formats are available:

- Implicit VR/little endian (default format)
- Explicit VR/little endian
- Explicit VR/big endian

Mx8000 Workstation Import Function

The Mx8000 **Import** function enables the user to import images that were created on a foreign system in DICOM format. Images can be imported from a floppy diskette or from an EOD cartridge.

After the images are copied to the Mx8000 hard disk, they are compressed and transferred automatically to the Mx8000 archives.

Creating an Import Device (Configuration)

1. From the **Configuration** application click on the local node.
2. From the **Add Device** list, click **File Import**. The **Device Configuration** window opens.
3. In the **Name** field, type in the name for the file import device, or use the default value.
4. In the **AE Title** field, type in the application entity title for the device, or use the default value.
5. In the **Input Directory** field type: **/usr/tmp/import** and press **<Enter>**. The images are copied to this directory.
6. From the **Input Format** list, choose the desired format. For details see *"Transfer Syntax"*.
7. The name in the **Target Device** field should be the same name you used for local disk in the device list.
8. Click **OK** several times to exit, and then confirm to reboot.

Importing Images

To copy the images from a diskette to the input directory, do the following:

1. Login as **Mx8000**.
2. Open a winterm (Use password: **letmein**).
3. Insert the diskette into the drive. Wait for a few seconds until it is recognized by the system.
4. Type: **cp /floppy/x /usr/tmp/import** and press **<Enter>**.
   (**x** = path and name of the image to be imported.)
5. Wait until the copying process is finished.
6. Type: **eject /floppy**

The images are automatically transferred to the Archive Manager and then deleted from directory **/usr/tmp/import**. View them by clicking the **Refresh** icon.

Copy images from an EOD Cartridge to the input directory as follows:

1. Set the cartridge to Write Protect and insert it into the EOD drive.
2. Click on the local EOD device icon in the Archive Manager to select it. Verify that the EOD icon is highlighted. You may not see any image on the patient list, since the format of the images is not recognized by Mx8000.
3. Open a winterm (password: **letmein**).
4. Type: **cp /EOD/3/x /usr/tmp/import** and press **<Enter>**.

   (**x** = path and name of the image to be imported. In case of a second EOD, type **4** instead of 3 in the line above.)
5. Wait until the EOD Drive Led stops blinking.
6. Eject the EOD Cartridge through the application, by right-clicking the mouse and selecting **eject**.
   The images are automatically transferred to the Archive Manager and then deleted from directory **/usr/tmp/import**. View them by clicking the **Refresh** icon.

Transfer Syntax

When DICOM devices communicate, they agree on possible formats for image transfer. In particular, they agree on whether the images are transferred in implicit or explicit value representation, and whether words are encoded in little or big endian. When accessing a floppy or an EOD cartridge, the format of the images has to be pre-defined.

Choose the format for image transfer that is appropriate for the format of the imported images. Get the format from the hospital Network Administrator.

The following formats are available:

- DICOM Implicit Little Endian (default format)
- DICOM Explicit Little Endian
- DICOM Implicit Big Endian
- DICOM Explicit Big Endian

LAN Configuration in MxTwin Station Connected to Mx8000 Workstation

This section describes how to perform LAN configuration in a MxTwin Station connected to an Mx8000 system.

1. Press **TESTS**, select **LAN Configuration**, and change **LAN** to **YES**.
2. Perform IP address configuration as follows:
   a. At the DOS **C:>** prompt type: **cd \xln\bin** and press **<Enter>**.
   b. Open the **tcp.bat** file using any DOS Editor (EDIT, EDLIN, Brief).
   c. In line 15 of the **tcp.bat** file change the IP Address to **192.1.1.x** (where **x** is the number which was assigned in the Mx8000 network configuration for the MxTwin station).
   d. Save the changes to file **tcp.bat**.
   e. Restart the system.
3. In the **LAN Configuration** program add the Mx8000 as a station, as described in Chapter 4 of Document 410-7152-2000, *“Communication Network for EXEL 2400-ELECT/Elite 2000 SPRINT and IDC-E/ELITE Systems”*.

4. Define the MxTwin device in the Mx8000 as follows:
   a. In the Mx8000 system, enter **Network Configuration**.
   b. In the **Device Configuration** dialog box enter the following parameters for the CT device:

NAME: **CT** *

AE Title: **proCT**

Local Station: **x** **

Remote Station: **y** ***

IP Address: **192.1.1.2**

*. If you are connecting more than one CT System, select different names.

. **x = ordinal number of the Mx8000 station (as displayed in the LAN Configuration program in the CT Console) **minus 1**.
For example: In the following: **2. pro 192.1.1.z**, x = 1 (2-1=1).

***. **y = ordinal number of the CT station** (as displayed in the LAN Configuration program in the CT Console) **minus 1**.
For example: In the following, **1. CT 192.1.1.w**, y=0 (1-1=0).

Mx8000 LAN Configuration Features

This section describes the following:

- LAN configuration procedure for pushing images from an MxTwin system to the Mx8000 (without using a PassPort).
- LAN configuration procedure for pushing images from a MxTwin system to a foreign DICOM workstation using the Mx8000 as a transparent Gateway.

> **NOTE:**
>
> In this document, MxTwin means the MxTwin family.

Pushing Images from MxTwin to the Mx8000 (without a PassPort)

To enable the pushing of images from an MxTwin system to the Mx8000 without using a PassPort, you need to perform LAN configuration on the MxTwin system and on the Mx8000.

An example of LAN Configuration procedure for direct pushing of images from a MxTwin scanner to an Mx8000 with two EODs is described below.

LAN Configuration on the MxTwin

If the Mx8000 is already defined without an EOD, skip to *Step 5*.

If the Mx8000 is already defined with an EOD, skip to *Step 8*.

If the Mx8000 is already defined with two EODs, skip to *“LAN Configuration on the Mx8000”*.

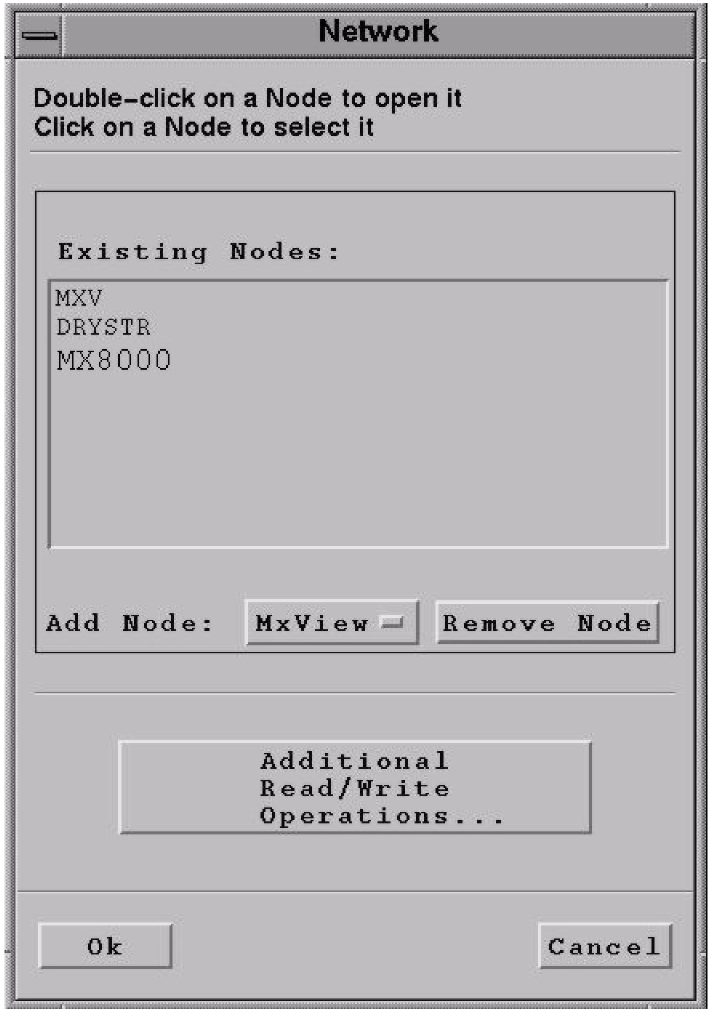
1. Press **[TEST]**, and select **LAN Configuration**. The **LAN Configuration** screen is displayed.
2. Highlight the MxView field using the up/down arrows. Press **<Enter>**. The **Station Configuration** screen is displayed.
3. In the **Fixed Disk Name** field type a name for the MxView fixed disk. The name should be no longer than five characters. Press **<Enter>**.

4. In the **Fixed Disk Full Name** field type a full name for the MxView fixed disk. Choose a name which describes the fixed disk. Press **<Enter>**.
5. With the down arrow highlight MxView. Press **<Enter>**. With the right arrow highlight **Add Device**. Press **<Enter>**.
6. The **Optional Device** screen opens. It includes the following four options (all Mx8000 Devices except for the local disk):
   - **OD**
   - **EOD**
   - **MT**
   - **DVC**
7. To push images to the Mx8000 EOD, you need to define an Mx8000 EOD. If you already have an EOD, skip to the next step. To add an EOD to the Mx8000 do as follows:
   a. In the **Optional Device** screen, highlight **Erasable Optical Disk**, and press **<Enter>**.
   b. The **Station Configuration** screen is displayed. Type the name of the Mx8000 EOD if you wish to change its name (for example EOD-1).
8. Add a second EOD, as follows:
   a. In the **Station Configuration** screen, highlight **Add Device**, and press <**Enter**>. The **Optional Devices** screen opens.
   b. Highlight **Optical Disk**, and press **<Enter>**. The **Station Configuration** screen opens.
   c. In the **Optical Disk Name** field type a name, e.g., EOD-2.
   d. In the **Optical Disk Full Name** field type a full name, e.g., OpticalDisk2.
9. Press **<Enter>**, and then **<Esc>** to return to the **LAN Configuration** screen.
10. Using the right arrow, move to the right edge of the screen and highlight **Save & Exit**. Press **<Enter>**. The system reboots automatically.

LAN Configuration on the Mx8000 Workstation

If the CT is already defined in the Mx8000, skip to *Step 11*.

1. Login as **config**. (Enter the password: **config95**).
2. Click **Network**. The Network window opens.
3. In the **Existing Nodes** list, double-click the local node (it is always the first entry in **Exiting Nodes** list). The Node Configuration window opens (see *Figure 8-25*).

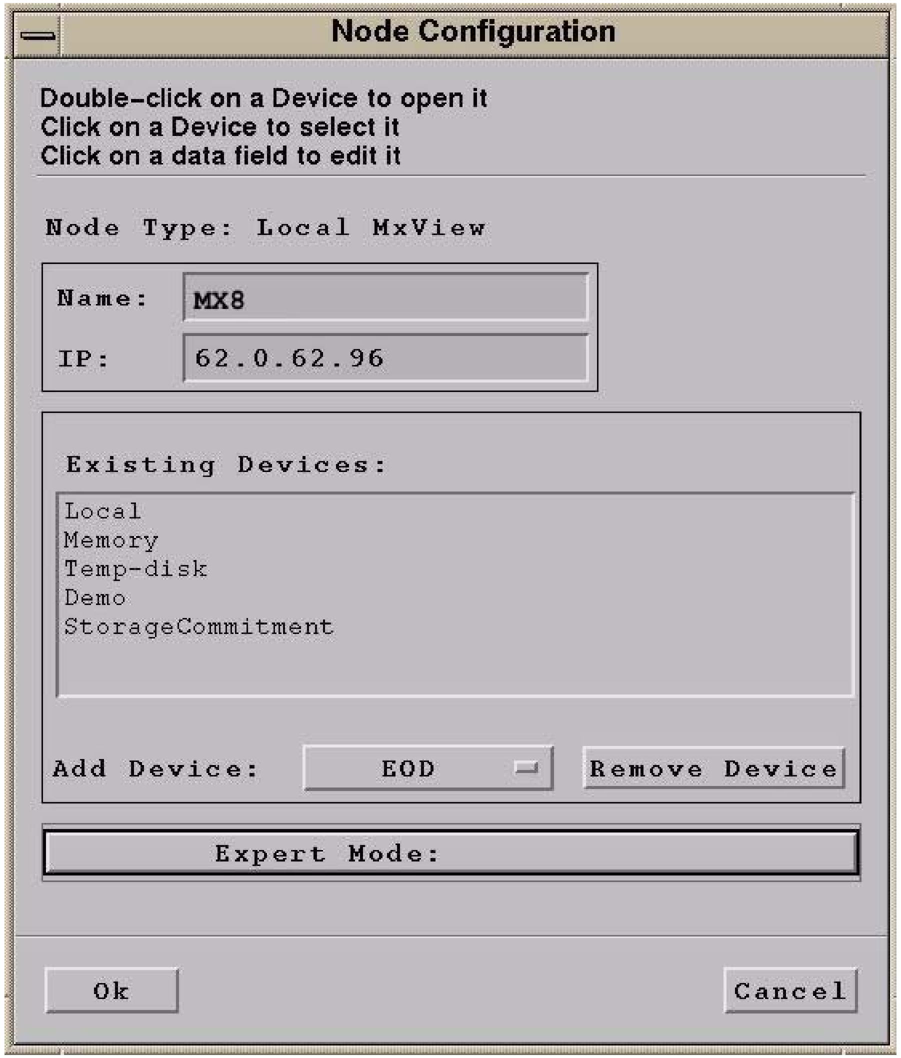

Network
Add Node:
MxView
Remove Node
Additional Read/Write Operations...
Ok
Cancel

Double-click on a Node to open it
Click on a Node to select it

Existing Nodes:
MXV
DRYSTR
MX8000

Figure 8-24:

4. If you need to define a new CT Station, proceed to *Step 5*. If a CT station is already defined, skip to *Step 10*.
5. In the Node Configuration window click the **EOD** button in the ADD Device list.
   The **Device List** pop-up menu opens. Click on **CT Station**.
6. The **Add Device** window opens (see *Figure 8-26*).



Node Configuration

Double-click on a Device to open it
Click on a Device to select it
Click on a data field to edit it

Node Type: Local MxView

Name: MX8

IP: 62.0.62.96

Existing Devices:

Local
Memory
Temp-disk
Demo
StorageCommitment

Figure 8-25:

7. Configure the CT Station as an Mx8000 Device, by entering the appropriate field names in the **Device Type: CT Station** dialog box.

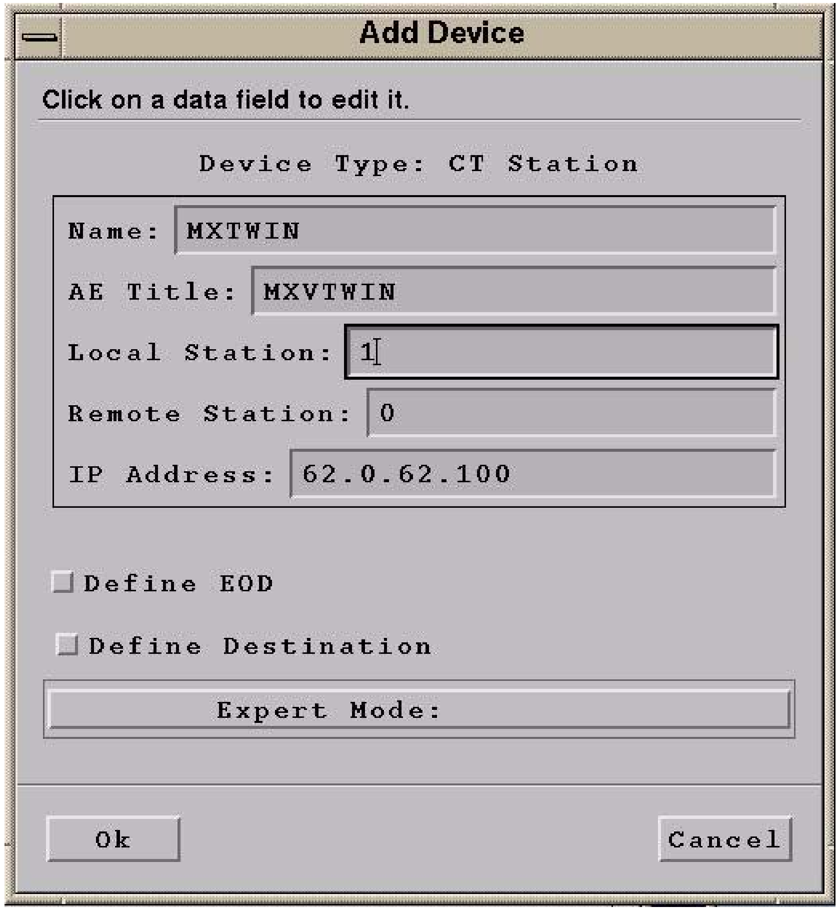
   For example: in the Device Configuration dialog box, enter the following parameters for the CT Device:

NAME: **CT** *
AE Title: **CT**
Local Station: **x** **
Remote Station: **y** ***
IP Address: **<IP Address>**

*. If you are connecting more than one CT System, select different names and AE Titles. You can enter names according to your choice.

. **x = ordinal number of the Mx8000 station (as displayed in the LAN Configuration program in the CT Console) **minus 1**.

***. **y = ordinal number of the CT station** (as displayed in the LAN Configuration program in the CT Console) **minus 1**.



Add Device

Click on a data field to edit it.

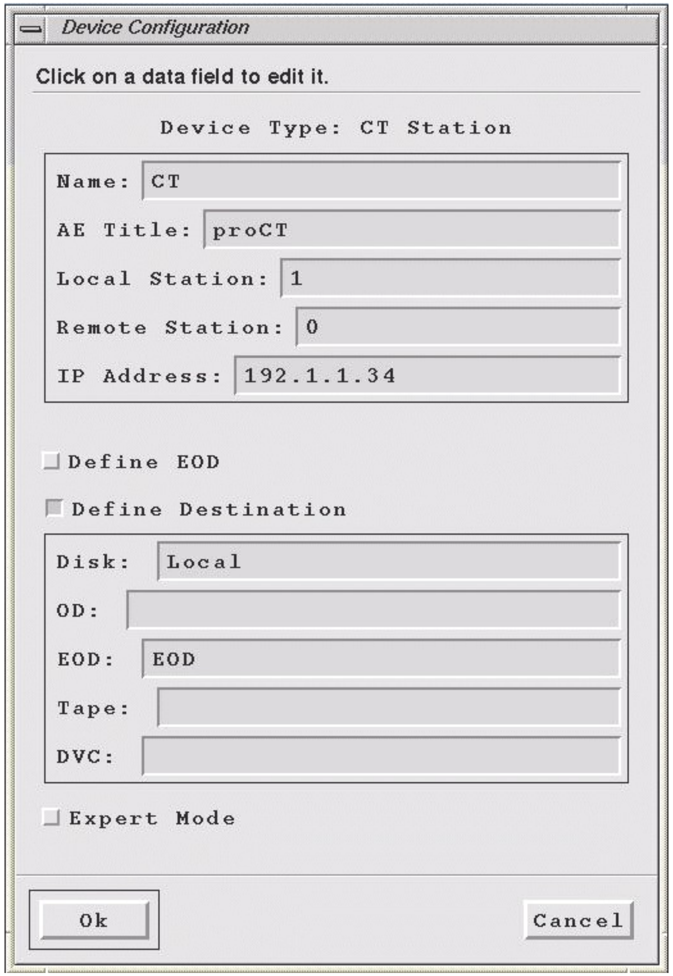
Device Type: CT Station

Name: MXTWIN
AE Title: MXVTWIN
Local Station: 1
Remote Station: 0
IP Address: 62.0.62.100

☐ Define EOD
☐ Define Destination

Figure 8-26:

8. Click **Define Destination**. The Define Destination dialog box expands to include five fields: **Disk**, **OD**, **EOD**, **Tape** and **DVC** (see *Figure 8-27*).
9. Skip to *Step 12*.
10. In the Node Configuration window, double-click the CT entry in the **Existing Devices** list. The Device Configuration window opens.



Click on a data field to edit it.

Device Type: CT Station

Name: CT
AE Title: proCT
Local Station: 1
Remote Station: 0
IP Address: 192.1.1.34

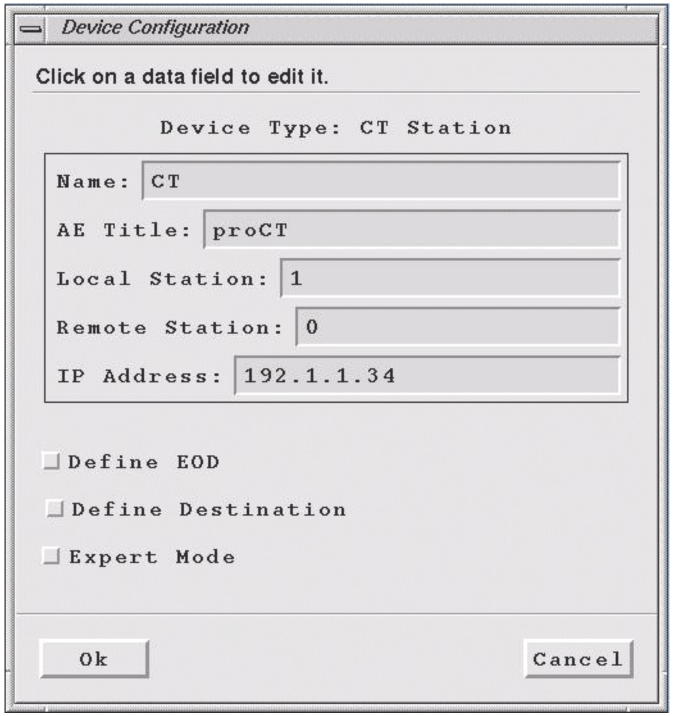
☐ Define EOD
☐ Define Destination

Disk: Local
OD:
EOD: EOD
Tape:
DVC:

☐ Expert Mode

Figure 8-27:

11. Click **Define Destination**. The Define Destination dialog box opens. See the lower half of *Figure 8-29*.



Click on a data field to edit it.

Device Type: CT Station

Name: CT

AE Title: proCT

Local Station: 1

Remote Station: 0

IP Address: 192.1.1.34

☐ Define EOD

☐ Define Destination

☐ Expert Mode

Figure 8-28:

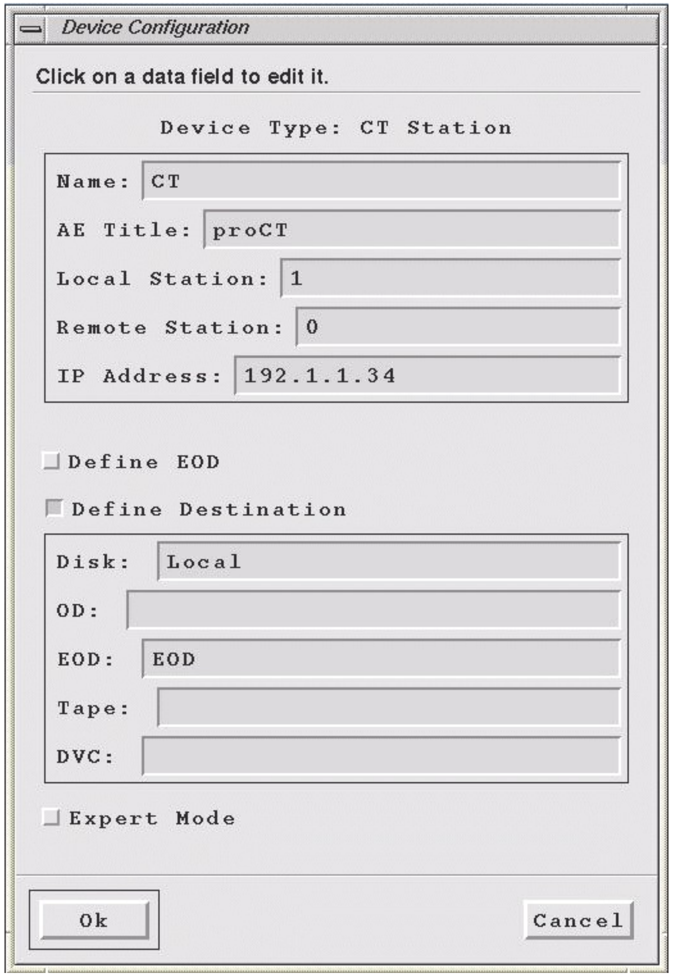
12. To choose a disk as the destination for pushed images, in the **Disk** field enter the name of the disk that appears in the Node Configuration window in the **Existing Devices** list (see *Figure 8-29*).

> **NOTE:**
>
> Field names are case sensitive.

13. To choose **EOD as destination** for pushed images, in the **EOD** field enter the name of the EOD that appears in the Node Configuration window in the **Existing Devices** list (see *Figure 8-29*).

    To remove an EOD device, delete the EOD name, and click **OK** to confirm.

14. To choose a second EOD as destination (EOD-2), if you have already configured a second EOD, skip to *Step 17*. Otherwise, perform *Step 15* and *Step 16*.



Click on a data field to edit it.

Device Type: CT Station

Name: CT
AE Title: proCT
Local Station: 1
Remote Station: 0
IP Address: 192.1.1.34

☐ Define EOD

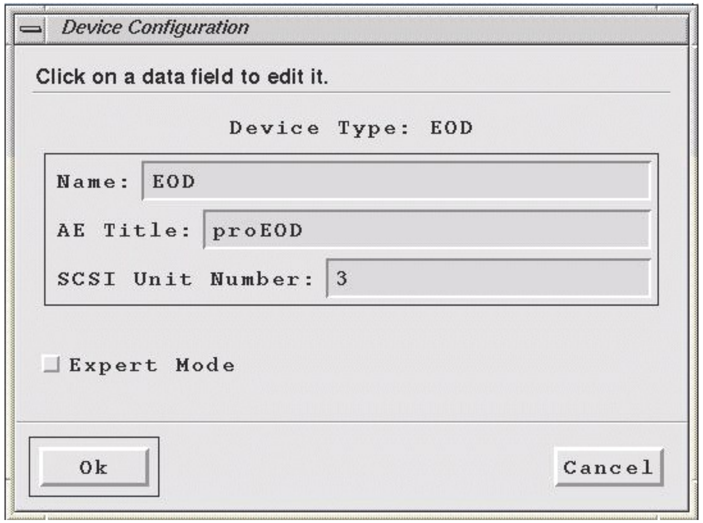
☐ Define Destination

Disk: Local
OD:
EOD: EOD
Tape:
DVC:

☐ Expert Mode

Figure 8-29:

15. Define the second EOD in the existing device list as follows:
    a. In the Node Configuration window click **EOD** button. The **Device List** pop-up menu opens.
    b. Click **EOD**. The window shown in *Figure 8-30* opens:
16. Configure the EOD as an Mx8000 device as follows:
    a. Change the **Name** field. In our example add the digit **2** to the previous name.
    b. Change the **AE Title** field. In our example add the digit **2** to the previous name
    c. Change the **SCSI Unit Number** field to **4**.
17. In the **OD** field (see *Figure 8-29*) enter the name of the second EOD that appears in the Node Configuration window in the **Existing Devices** list (see *Figure 8-29*.
18. Click **OK** several times to confirm the configuration.
19. Click **Exit** and **OK**. The system reboots.



Click on a data field to edit it.

Device Type: EOD

Name: EOD

AE Title: proEOD

SCSI Unit Number: 3

☐ Expert Mode

Figure 8-30:

Pushing Images from a MxTwin Scanner to a Foreign DICOM Workstation Using the Mx8000 as a Transparent Gateway

LAN configuration for pushing of images from a MxTwin system to a foreign DICOM workstation by using the Mx8000 as a transparent Gateway is described in *“LAN Configuration on the MxTwin”* & *“LAN Configuration on the Mx8000”* below.

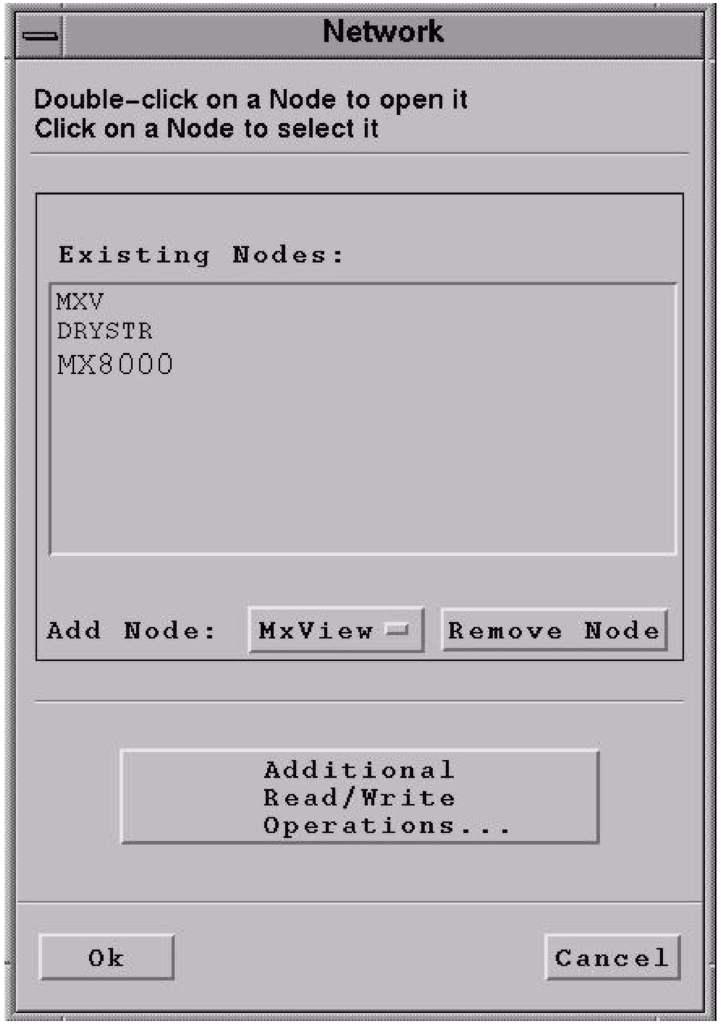
It is assumed that: The Mx8000 with its hard disk and EOD have already been defined in the CT, and the foreign station has already been defined on the Mx8000. Therefore, we include only instructions for LAN configuration on the MxTwin System and on the Mx8000.

LAN Configuration on the MxTwin

1. Press **[TEST]**, and select **LAN Configuration**. The LAN Configuration screen is displayed.
2. Highlight the MxView field using the up/down arrows. Press **<Enter>**. The **Station Configuration** screen is displayed.
3. With the right arrow highlight **Add Device**. Press **<Enter>**.
4. The **Optional Device** screen opens. It includes three available options:
   - — **OD**
   - — **MT**
   - — **DVC**
5. To push images to a foreign station, you need to define the foreign station as a device of the Mx8000. To add the foreign station as a device to the Mx8000 do as follows:
   a. In the Optional Device screen, highlight one of the devices (in our example highlight **OD**, since the EOD is used) and press **<Enter>**.
   b. The Station Configuration screen is displayed. Type the name of the foreign station.
6. Press **<Enter>**, and then **<Esc>** to return to the LAN Configuration screen.
7. Using the right arrow, move to the right edge of the screen and highlight **Save & Exit**. Press **<Enter>**.
8. The system reboots automatically.

LAN Configuration on the Mx8000

1. Login as **config**. (Enter the password: **config95**).
2. Click **Network**. The Network window opens.
3. In the **Existing Nodes** list, double-click the local node (it is always the first entry in **Exiting Nodes** list). The Node Configuration window opens.


Network

Double-click on a Node to open it
Click on a Node to select it

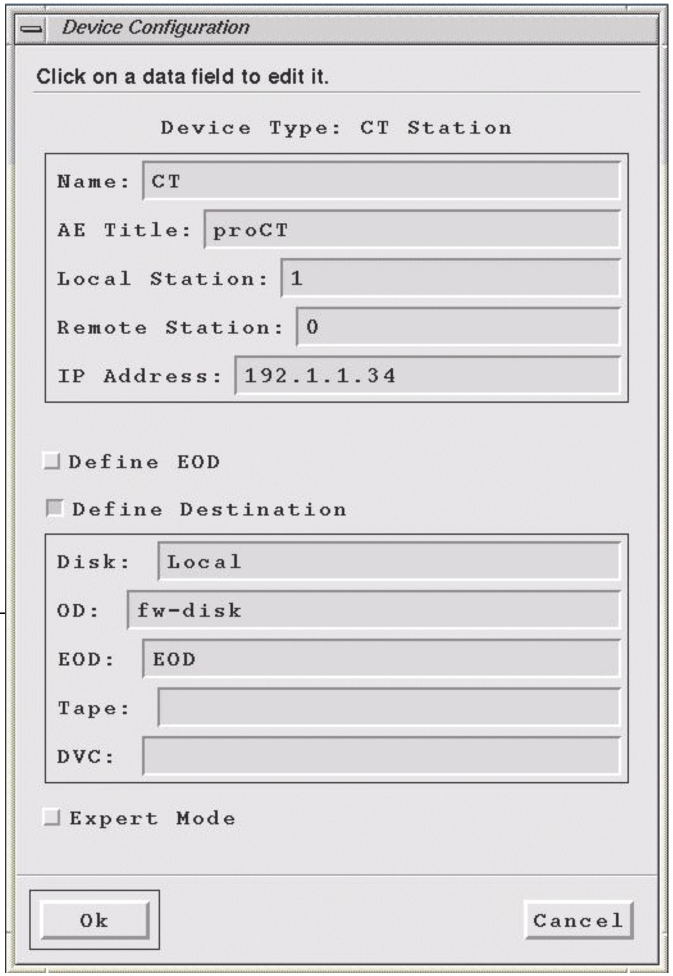
Existing Nodes:

MXV
DRYSTR
MX8000

Add Node:
MxView
Remove Node
Additional Read/Write Operations...
Ok
Cancel

Figure 8-31:

4. In the Node Configuration window, double-click the CT entry in the **Existing Devices** list. The Device Configuration window opens.
5. Click **Define Destination**. The Define Destination dialog box expands (see *Figure 8-32*).
6. Enter a name for the foreign station device you defined (the **OD** field in *Figure 8-32*). The name of the foreign station device appears in the Node Configuration window in the **Existing Devices** list (see *Figure 8-33*).



Click on a data field to edit it.

Device Type: CT Station

Name: CT
AE Title: proCT
Local Station: 1
Remote Station: 0
IP Address: 192.1.1.34

☐ Define EOD

☑ Define Destination

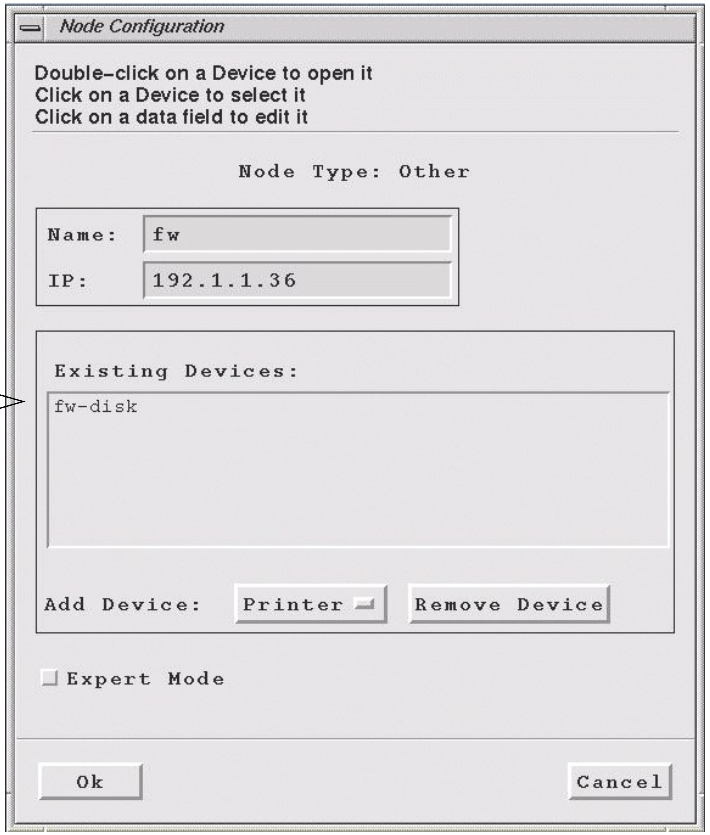
Disk: Local
OD: fw-disk
EOD: EOD
Tape:
DVC:

☐ Expert Mode

Device Field

Figure 8-32:

7. Click **OK** several times to confirm.
8. Click **Exit** and **OK**. The system reboots.


Station Device
Node Configuration
Add Device:
Printer
Remove Device
☐ Expert Mode
Ok
Cancel

Double-click on a Device to open it
Click on a Device to select it
Click on a data field to edit it

Node Type: Other

Name: fw

IP: 192.1.1.36

Existing Devices:

fw-disk

Figure 8-33:

Network Connection Testing and Troubleshooting

Network Testing

Network Tests include checking of TCP/IP Layer, CT LAN and DICOM interface.
These tests are performed:

- Network software of the Mx8000.
- Build-in network hardware of the Mx8000 system.
- Basic and optional external network hardware, including:
  - 10Base2 and 10BaseT network
  - Ethernet 8 port Hub

NOTE:

Tests can be performed between:

- Mx8000 and another computer (PC, CT Console) (see *“Basic Network Test”*)
- Mx8000 and a CT Scanner (see *“Image Transfer Test between Mx8000 and MxTwin / Elite Family”*)
- Mx8000 and MxView or SeleCT (see *“Image Transfer Test between Mx8000 and MxView or SeleCT”*)

Basic Network Test

The testing procedure is based on the **ping** utility. This utility sends packets from the tested Mx8000 to another computer that is connected to the same network. The other computer returns every packet it receives to the sender of the packet (in our test, the packets are sent from and returned to the Mx8000).

The **ping** utility also displays every returned packet, thus enabling the user to see if the network is operating OK.

Hardware Setup

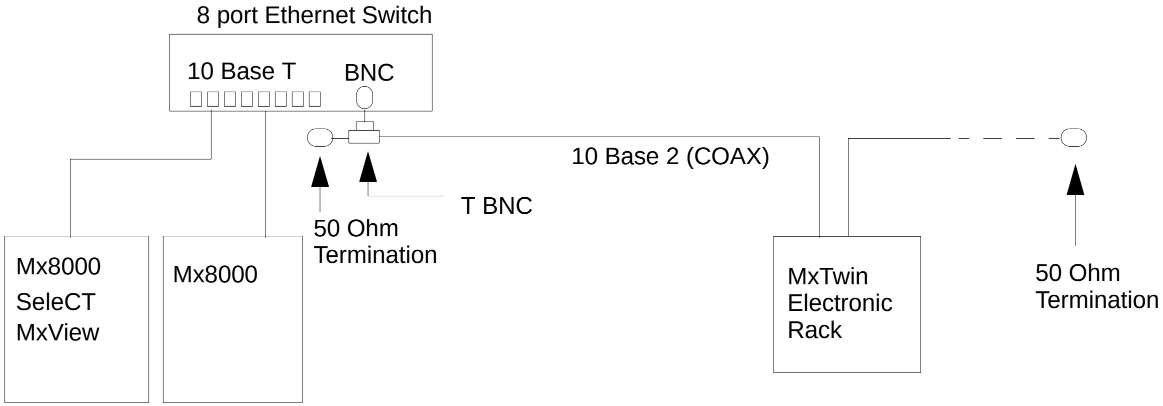

8 port Ethernet Switch
10 Base T
BNC
10 Base 2 (COAX)
T BNC
50 Ohm Termination
Mx8000
SeleCT
MxView
Mx8000
MxTwin Electronic Rack
50 Ohm Termination

Figure 8-34: Block Diagram

Switch Setup

1. Connect the Switch to the main power outlet.
2. If connection to a MxTwin system is needed, use the 60m coax cable. Connect one end of the cable to the BNC port of the Switch using the T BNC and the 50Ω termination. Connect the other end of the cable to the Computer Rack.
3. Other stations may be connected to the LAN either to the coax using additional T BNC connectors or to the remaining 10BaseT ports of the Switch.

Setting the IP Address

The IP address consists of four fields (for example 192.132.141.211). The first three fields are the IP network address. The fourth field is the node address of the workstation.

Mx8000 and the other computer should be configured to have the same IP network address, so that they can access one another over the Ethernet. (the first three numbers of their IP addresses should be the same).

Computers on the same network should have individual node numbers.

To set the IP address of the Mx8000 workstation:

1. Login as **root** (use password: **pkserv99**).
2. From the **System** menu in the toolchest, choose **System Manager**. The System Administration window opens-up.
3. In the menu at the left of the System Administration window choose **Network and Connectivity,** and in the menu at the right choose **Network Interface Manager**. The Network Interface Manager window opens-up.
4. Click **Configure**.
5. In the next window, click **Next**.
6. In the next window, click **Next**.
7. Type the IP Address in the appropriate field. Verify that the **Use default netmask** checkbox is checked.
8. Click **Next**.
9. Click **OK** to confirm your settings.
10. Close all open windows. Restart is not required.

NOTE:

After setting the IP Address, the system is automatically set to "Network Mode" (as opposed to "Stand-Alone Mode").

Testing

1. When the connection is set up, login as **root**.
2. In a shell window, type: **ping <IP-address-of-the-other-computer>** and press **<Enter>**.
   For instance, if the IP address of the other computer is 192.132.141.211, type: **ping 192.132.141.211**
3. If everything is OK, lines like the following appear on the screen:

```
PING 192.132.141.211 (192.132.141.211): 56 data bytes
64 bytes from 192.132.141.211: icmp_seq=0 ttl=255 time=2 ms
64 bytes from 192.132.141.211: icmp_seq=1 ttl=255 time=1 ms
64 bytes from 192.132.141.211: icmp_seq=2 ttl=255 time=1 ms
64 bytes from 192.132.141.211: icmp_seq=3 ttl=255 time=1 ms
```

NOTE:

The IP address 192.132.141.211 above is only an example. Actually, the IP address that you used with ping appears.

4. If a fault is detected in the network, one of the following may occur:
   - Only one line appears:
     PING 192.132.141.211 (192.132.141.211): 56 data bytes
   - The **icmp_seq** variable displayed in each line is not incremented by 1 from line to line.

   If this is the case, look for a network problem, such as:

   - Ethernet cable not properly connected to the transceiver of the Mx8000 or to transceiver of the other computer.
   - Ethernet cable damaged.
   - Transceiver not properly connected to the Mx8000 or to the other computer.
   - Ethernet cable not properly terminated. (The cable should be terminated with 50Ω termination at both ends.)
   - IP address of the Mx8000 or of the other computer not set properly.
   - TCP/IP software not properly installed on the other computer or on the Mx8000.

Image Transfer Test between Mx8000 and MxTwin / Elite Family

This section includes instructions for testing image transfer, as follows:

- Transfer of images from Mx8000 to CT scanner and vice versa
- Conversion from DICOM to CT format and vice versa.

Setup

1. Configure a network which contains the Mx8000 and a CT station for pulling/pushing to the Mx8000.
2. Change the Internet Address (IP address) of the Mx8000 to **192.1.1.1** and the IP address of the CT station to **192.1.1.2**.
3. Change the network configuration of the CT station so that it recognizes the Mx8000.
4. Change the network configuration of the Mx8000, as follows:
    a. Login as **config** (Use password: **config95**).
    b. Click **Network**, to enter Network Configuration.
    c. Open the Node Configuration dialog box for the local node, and add the CT Station device.
    d. Type in the Internet Address of the CT Station, and the numbers of the local station and remote station.

Testing

1. Login as **Mx8000**.
2. Click the CT Station icon in the Archive Manager.
3. Select one of the studies.
4. From the **File** menu choose **Copy images**, to copy the images.
5. In the dialog box, select the Local device as the destination for the copied images. Click **OK**.
6. Click the CT Station icon again to de-select it.
7. Select the local disk, and the study which you have just copied. Click the **Refresh** icon to update the display, and wait until all the images of the study are copied.
8. Copy some other studies in the same way.
9. Use the Queue Manager to view the transfer process. To activate the Queue Manager, select **Queue Manager** from the **File** menu of Archive Manager.

    You have completed Network testing.

If the Mx8000 is a standalone system, change its Network Configuration back to standalone mode, as follows:

1. Login as **config**.
2. Enter **Network Configuration**.
3. Enter Node Configuration, and remove the CT station device.
4. Exit the Network Configuration session.
5. Change the Internet Address of the Mx8000 back to the default value: **192.0.0.1**

Image Transfer Test between Mx8000 and MxView or SeleCT

Setup

1. Configure an Mx8000, MxView or SeleCT system for transferring images between an Mx8000 and MxView or SeleCT.

> **NOTE:**
>
> Enter a different AE Title for each system.

2. Connect the Mx8000, MxView or SeleCT to the Switch, using RJ45 or 10Base2 cable (coax).

Testing

1. Click the remote system Archive, to view it.
2. Select images to view.
3. Load a set of images to the Viewer.
4. Open the Queue Manager, to verify that all images have been transferred.
5. Verify that image parameters are correct, and image quality is good (both on disk and on the EOD). Do the same on the remote system.

Diagnosing Software Problems

This section describes some of the common software problems and their possible causes, as well as ways to overcome the problems.

- User **Mx8000** requires a password

  Normally, the **Mx8000** user requires no password. However, it is possible to protect this login with a password. If you want to delete the password from **Mx8000** (for example, if you do not know the password), login as root, open a unix shell window and type: **passwd -d mx8000** and press **<Enter>**

- When trying to login as **Mx8000**, the workstation returns to the login screen after a few seconds.

  This can happen if the software license is incorrect. Make sure you entered the correct software license.

- **All devices in the Archive Manager are not responding**.

  The network configuration files may be corrupted.

- **A new device which was added to the Archive Manager is not responding**.

  Some of the parameters of the new device are incorrect.

- **An application (for example, oblique) does not appear in the *Processing* menu**.

  This application was not installed as a Software Option. Make sure you have requested this application in the Software License Request form.

Disabling the Workstation Password

A prompt for a password may appear if you select the **Install System Software**, **Run Diagnostics**, **Recover System** or **Enter Command Monitor** icon from the **System Maintenance** menu.

If you do not know the password, you can disable it (see "*Mx8000 Workstation Owner’s Guide Hardware installation and troubleshooting*.”).

Printing Problems - AMC (Laser Multi Imager Interface) Not Working

1. Make sure that the PWR LED is on, indicating that power is applied to the AMC and that the power switch is on. Otherwise, check the following:
   a. Power switch is on.
   b. Fuse is OK.
   c. Power cord is OK
   d. Power strip is OK.

The AMC device has a fuse in the fuse compartment adjacent to the ON/OFF switch. A spare fuse is located inside the fuse compartment.

2. To replace the fuse:
   a. Disconnect the power cable from the AMC.
   b. Using a screwdriver or fingernail, remove the fuse compartment by releasing the holder.
   c. Replace the fuse with the supplied spare fuse (PN F_00055000M).
   d. Return the fuse compartment to its place.
3. If the **Xfer** LED is constantly ON, and no films are printed, reset the AMC by powering OFF and ON again.
4. Check that all cables are connected properly, as described in *“Installing the AMC Device (AMC-4 Option)”*. If image transfer to the LMI fails regardless of the operating method (probably followed by a time out message from the LMI), perform the self test included in the confidence test and the suggested remedies (see *“AMC Confidence Tests”*).
5. If your AMC version does not support operation by a footswitch, skip *Step 6* & *Step 7*, and proceed to *Step 8*.
6. If image transfer to the LMI succeeds when you issue a print command from an Mx8000 application or from the LMI keypad, but fails when the footswitch is pressed, perform the following steps:
   a. Check that the footswitch IN cable is properly connected.
   b. Replace the footswitch IN cable.
   c. Replace the footswitch (if a spare is available).
   d. Replace the AMC device.

7. If the image transfer to the LMI succeeds when you issue a print command from an Mx8000 application, but fails when initiated by footswitch or by the LMI keypad, perform the following:
    a. Check that the host serial cable is properly connected.
    b. Replace the host serial cable.
    c. Replace the AMC device.
8. If printing to a local printer fails, perform the following:
    a. Verify that the printer is on-line.
    b. Check that the printer cable is properly connected to the AMC.
    c. Check that images are sent to the LMI. Otherwise, perform remedies accordingly.
    d. Perform the local printer test included in the confidence test and perform the remedy (see *“AMC Confidence Tests”*).

AMC Confidence Tests

AMC confidence tests ensure that the AMC device is functioning correctly. They also include remedies to overcome some possible problems. The AMC must be connected as shown in *“Installing the AMC Device (AMC-4 Option)”*.

This section describes the following tests:

- Self Test
- Printing Test Images
- Local Printer Test
- Printing a Test Pattern from Mx8000 Application Software

Self Test

The following test requires an operating Mx8000 workstation.

1. Connect all the cables as explained in *“Installing the AMC Device (AMC-4 Option)”*. Switch the AMC on (power switch on the rear panel). Verify that only the power LED is on.
2. On the Mx8000 keyboard, type: **cd /usr/tamar.root/bin** and press **<Enter>**.
3. Type: **amc_selftest** and press **<Enter>**.

4. Verify that the message **self test successful** appears on the screen. Otherwise, replace the host parallel cable. Check that the parallel port of the workstation is functioning. If more failures occur, replace the AMC device.

Printing Test Images

Proceed to this test only if the self test passed. This test verifies the proper operation of the AMC in various modes. The test requires a connection to an operating LMI. The normal operation of the LMI can be verified by connection to other medical equipment (if available).

To set up the test:

1. Use the LMI keypad to setup a 12 image film format. (To complete this test with a 3M 952 LMI, disconnect the LMI 952 SERIAL cable, and connect the keypad).
2. If your LMI is configured to work with even parity, type: **amc_print_test** and press **<Enter>**.
   If your LMI is configured to work with odd parity, type: **amc_print_test -po** and press **<Enter>**.
3. Perform the program instructions. The program includes three phases. In case of a failure, replace:
   — Phase 1: Footswitch OUT cable or LMI parallel cable or AMC device.
   — Phase 2: Host serial cable or footswitch IN cable or AMC device.
   — Phase 3: AMC device.

   Verify that the message **print test successful** appears.

Local Printer Test

This test requires a parallel (Centronics) printer with its own parallel data cable. To test the AMC local printer link, perform the following steps:

1. Switch the printer on. Make sure the printer is on-line.
2. Type: **amc_lp_test** and press **<Enter>**.
3. Verify that the following text was printed:
   the quick brown fox jumped over the lazy dog back 0123456789
4. Verify that the message **test completed** appears on the screen. Otherwise, check that the printer cable is properly connected to the AMC. Replace the cable if necessary. The printer may be checked separately when connected to another device such as a PC. If failures persist, replace the AMC device.

Printing a Test Pattern Image from Mx8000 Application Software

The following test requires that the Mx8000 is configured to include a local connection to the LMI.
Perform the following steps:

1. Login as **Mx8000** (no password required).
2. In the Archive Manager, click the **Demo** device icon. After a few seconds, a list of patients appears.
   a. From the **View** menu, select **Image List**.
   b. Select the patient names **PATTERN** (by clicking the line of the patient). The list of images for this patient is displayed.
   c. Click on Image number **1** of series number 1.
   d. From the **File** menu select **Film**.
3. From the **Tasks** menu of the Archive Manager, select **MasterFilm** to open the **Film Previewer** application.
4. From the File menu choose Select Printer, then select your configured LMI printer.
5. From the File menu select Set Film Format / 1x1 format.
6. In the LMI keypad select a 1x1 format.
7. From the File menu select Print Film to print the grayscale pattern image.
8. Check the grayscale and the resolution of the printed image.
9. Logout (use File / Logout in the Film Previewer).

Chapter 9
Cabling

Cabling 9-1

Abbreviations 9-2
System Cabling 9-3
  System Cables List 9-4
Gantry Stationary Cabling 9-8
  Gantry Stationary Cables List 9-9
Gantry Rotating Cabling 9-25
  Gantry Rotating Cabling List 9-26
Ground Rules 9-34
  Overview 9-34
  High Voltage Circuit 9-35
  CAN Bus Wiring 9-35

Cabling

Select the needed cabling area:

Cabling of the system	W1 ... W49 - Reserved for power cables. W50 ...W99 - Reserved for data cables.
Cabling of Gantry Stationary	W340 ... W349 - Reserved for power cables. W390 ... W399 - Reserved for data cables.
Cabling of Gantry Rotating	W500 ... W549 - Reserved for power cables/ W550 ... W599 - Reserved for data cables.

In addition to the above, the following wire numbers (W#) are reserved for the list of components:

Cabling of Power Distribution Cabinet	W100 ... W199
Cabling of the DMS	W400 ... W499
Cabling of the High Voltage Generator	W600 ... W699
Cabling of the Patient Table	W700 ... W799

Cables for SAS injectors are found in Section *“Injector Cable and Wiring Diagrams”* in Chapter 10.

Abbreviations

The following abbreviations are used in the cables list and drawings:

CONV	Converter
DMS	Data Measurement System
FC	Frequency Converter
GND	System Ground
N.A.	Not Applicable
PCB	Printed Circuit Board
PHC	Patient Handling Control
PE	Protective Earth
PSS	Power Supplies Stationary
ROT	Rotation
ROT_CONTROL	Assembly of frequency converter, wiring and connectors
RTS	Rotating and Tilt System
TBD	To be Determined

System Cabling

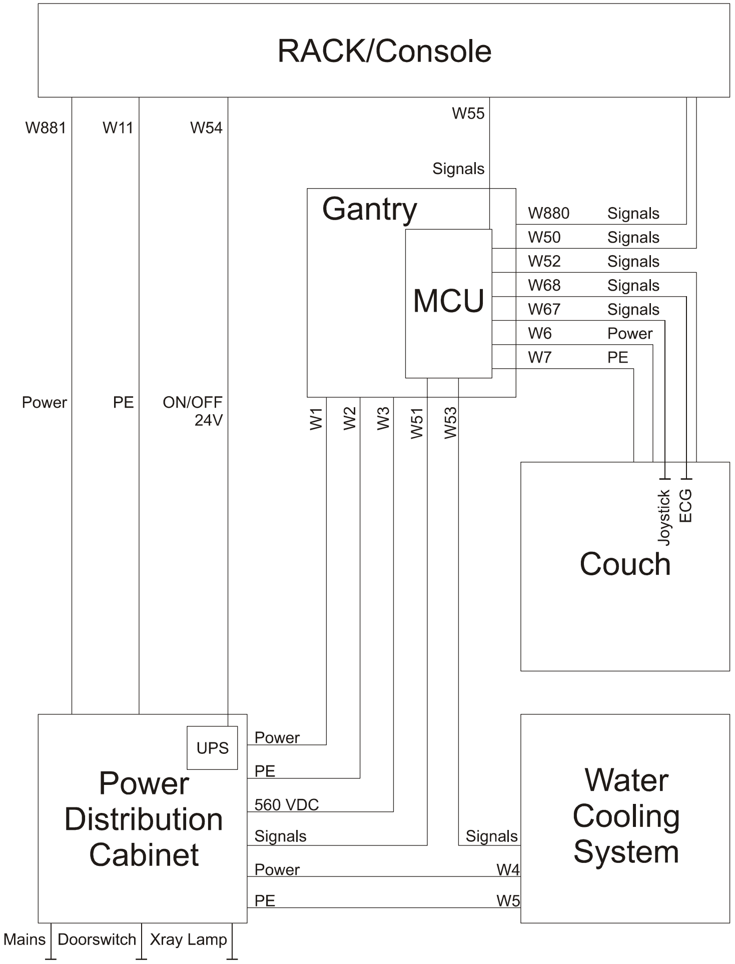

RACK/Console
W881
W11
W54
W55
Signals
Gantry
MCU
W880 Signals
W50 Signals
W52 Signals
W68 Signals
W67 Signals
W6 Power
W7 PE
Power
PE
ON/OFF
24V
W1
W2
W3
W51
W53
Joystick
ECG
Couch
UPS
Power
Distribution
Cabinet
Power
PE
560 VDC
Signals
Signals
Power
W4
PE
W5
Water
Cooling
System
Mains
Doorswitch
Xray Lamp

Figure 9-35: System Cabling Layout

System Cables List

Table 9-3: List of System Cables

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W1	PDC X257 AMP, M-Type, 33 pos. male	Gantry, PSS Z301 ring tongue, M6 X301, MNL, 6 pos. X305, MNL, 3 pos. X314, MNL, 4 pos. X301, X305, X314= female	Gantry: 400V~ / 13AT fuse Table: 230V~ / 6AT Table: 230V~ / 2AT mains2: 230V~ / 10AT Gantry over-temp: 24V= Slipring PWR-Sw: 24V= length=16m or 25m
W2	PDC X100 connector block ring tongue, M6	Gantry, PSS PE 301 ring tongue, M6	PE for Gantry (PE_GAN) 35^2 length=16m or 25m
W3	PDC D450, X7 .... X10; cable shield connected to housing; ring tongue, M6	Gantry, PSS X303.1 ... 4; cable shield connected to Gantry; ring tongue, M6	Rectifier output 560V=/ 250A (peak) 2 x 2 x 16^2 with shield Shorten to needed length.
W4	PDC X260 140.MNL, 9 pos. male	WCS X1 140.MNL, 9 pos. female	Supply - WCS 460V~/ 20AT (60 Hz) 400V~/ 20AT (50 Hz) Shorten to needed length.

Table 9-3: List of System Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W5	PDC X100 connector block ring tongue, M6	WCS X2 ring tongue, M6	PE for WCS (PE_WCS) 10^2 Shorten to needed length.
W6	Gantry, PSS X301 MNL, 6 pos. male	Patient Table X701 MNL, 6 pos. female	Supply - Patient Table 230V~ / 6 AT 230V~ / 2 AT length = 2.53m
W7	Gantry, PSS PE 303 ring tongue, M5	Patient Table PE 700 ring tongue, M6	PE - Patient Table length = 2.42m
W11	PDC connector block, X100 ring tongue, M6	Computer Rack ring tongue, M6	PE_IRS 10^2 length = 16m or 25m
W50	Gantry MCU_RTC (D301), X13 Sub-D, 50 pos. female	Computer Rack Sub-D, 50 pos. female	CAN, StopRep, Control Audio, Noise cancellation 2 x serial interface length = 16 m or 25 m
W51	Gantry U_RTC (D301), X14 Sub-D, 9 pos. female	PDC D451, X3 Sub-D, 9 pos. female	CAN, StopRep, Control length = 16m or 25m

Table 9-3: List of System Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W52	Gantry MCU_RTC (D301), X16 Sub-D, 9 pos. female	Patient Table X702 Sub-D, 9 pos. female	CAN, StopRep, Control length = 2.72m
W53	Gantry MCU_RTC (D301), X15 Sub-D, 9 pos. female	WCS X3 Sub-D, 9 pos. female	Control Shorten to needed length.
W54	Computer Rack Sub-D, 15 pos. female	PDC X250 Sub-D, 15 pos. male	ON/OFF/COMP-ON, 2 x UPS control length = 16m or 25m
W55	Gantry, PSS X321 ST male	Computrt Rack ACQ Card male	Measurement data fiber, 62.5 um length = 30m
W67	PHC GPC (D311), X9 Sub-D, 15 pos. female	Patient Table X703 Sub-D, 9 pos. male	Wiring to the interconnector within the Patient Table for the joystick (X705), controlling the horizontal table position
		Gantry X315 Cannon, circular, 4 pos. male	Wiring to the interconnector for the footswitch2, controlling the table height

Table 9-3: List of System Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W68	Gantry U_RTC (D301), X23 Sub-D, 9 pos. female	Patient Table X704 Sub-D, 9 pos. male	Wiring to the interconnector within the Patient Table (X707) for ECG
W880	Computer Rack	Gantry	Signals for GPC
W881	PDC	Computer Rack	Power to Computer Rack

Gantry Stationary Cabling

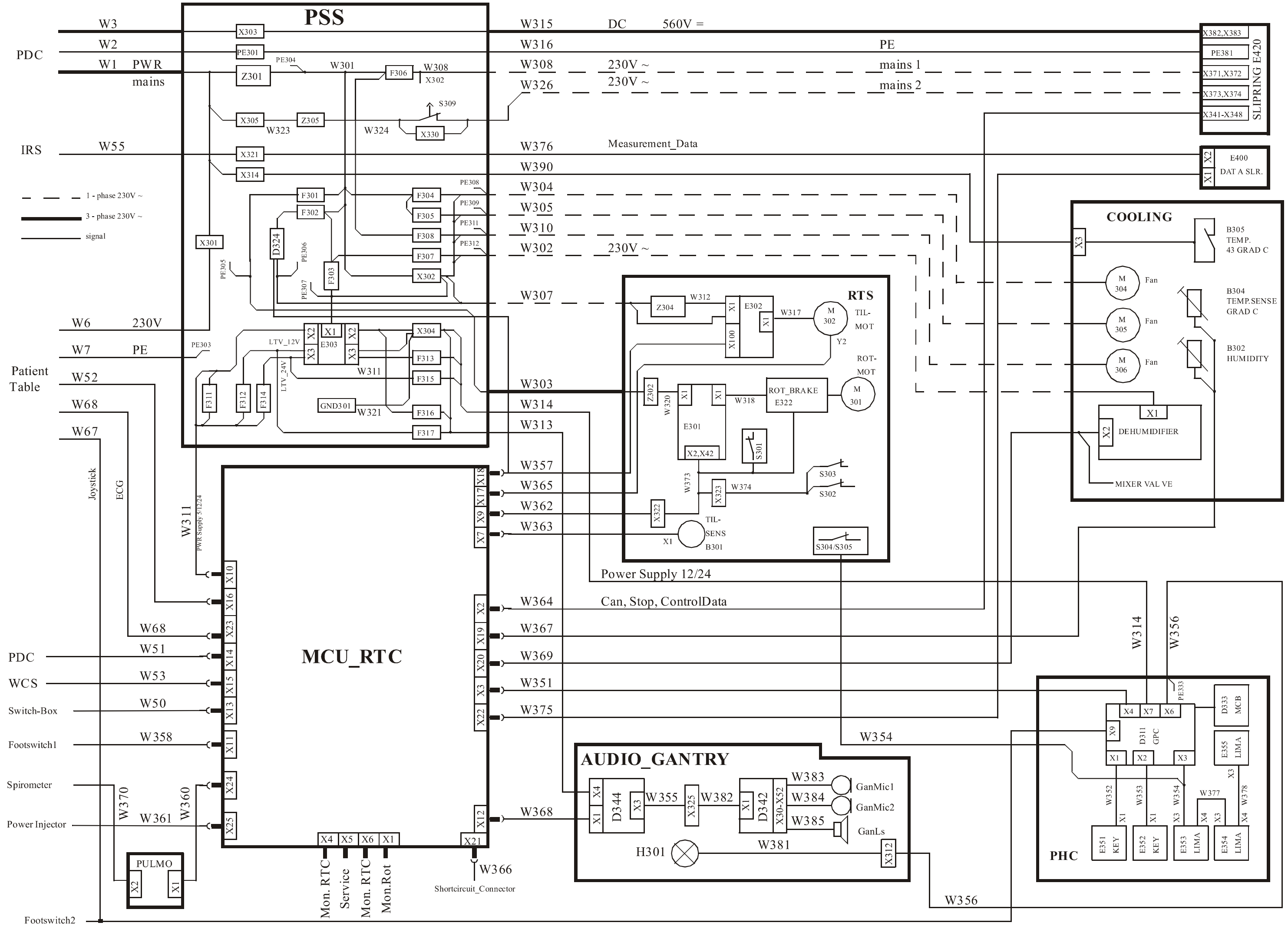

PSS
PDC
W3
W2
W1 PWR mains
X303
PE301
PE304
Z301
W301
F306
W308
X302
X305
Z305
W323
W324
S309
X330
IRS
W55
X321
X314
1 - phase 230V ~
3 - phase 230V ~
signal
X301
F301
F302
D324
PE305
PE306
PE307
F303
F304
F305
F308
F307
X302
PE308
PE309
PE311
PE312
W6 230V
W7 PE
PE303
LTV_12V
LTV_24V
X1
X2
X3
E303
X304
F313
F315
W311
GND301
W321
F316
F317
F311
F312
F314
Patient Table
W52
W68
W67
Joystick
ECG
W311
PWR Supply 5/12/24
W315 DC 560V =
W316 PE
W308 230V ~ mains 1
W326 230V ~ mains 2
X382,X383
PE381
X371,X372
X373,X374
X341-X348
SLIPRING E420
W376 Measurement_Data
W390
E400 DAT A SLR.
W304
W305
W310
W302 230V ~
W307
W303
W314
W313
RTS
Z304
W312
E302
X100
W317
M 302
TIL-MOT
Y2
ROT-MOT
Z302
W320
E301
W318
ROT_BRAKE E322
M 301
X2,X42
S301
S303
S302
W373
X323
W374
X322
TIL-SENS B301
S304/S305
COOLING
B305 TEMP. 43 GRAD C
M 304 Fan
M 305 Fan
M 306 Fan
B304 TEMP.SENSE GRAD C
B302 HUMIDITY
DEHUMIDIFIER
MIXER VAL VE
MCU_RTC
W357
W365
W362
W363
X18
X17
X9
X7
X10
X16
X23
X14
X15
X13
X11
X24
X25
X2
X19
X20
X3
X22
X12
X21
W364
W367
W369
W351
W375
W368
Power Supply 12/24
Can, Stop, ControlData
PDC W51
WCS W53
Switch-Box W50
Footswitch1 W358
Spirometer
Power Injector
W370
W360
W361
PULMO
Footswitch2
X4 X5 X6 X1
Mon. RTC
Service
Mon. RTC
Mon.Rot
W366
Shortcircuit_Connector
AUDIO_GANTRY
D344
W355
X325
W382
D342
X30-X52
W383 GanMic1
W384 GanMic2
W385 GanLs
H301
W381
X312
W354
W356
W314
W356
PHC
PE333
D311 GPC
D333 MCB
E355 LIMA
W352
W353
W354
W377
W378
E351 KEY
E352 KEY
E353 LIMA
E354 LIMA

Figure 9-36: Gantry Stationary Cabling Layout

Gantry Stationary Cables List

Table 9-1. List of Gantry Stationary Cables

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W301	Z301 - L1 (load side) 2 x ring tongue	F301, F302 (fuse input) 2 x crimp-type end-splice	Load side of the line filter for the 3-phase current to the fuses, common N and PE
	Z301 - L2 (load-side) 2 x ring tongue	F301, F304 (fuse input) 2 x crimp-type end splice	
	Z301 - L3 (load-side) 2 x ring tongue	F301, F306 (fuse input) 2 x crimp-type end-splice	
	Z301 - N (load-side) 2 x ring tongue	X302, X302 2 x receptacle	
	Z301 - PE (load-side) 1 x ring tongue	PE04 1 x ring tongue	
	F 302 - L1 (fuse output) 1 x crimp-type end-splice	D 324 (Power input) 1 x ring tongue	Fuse outputs --> solid state relay switch contact input (stop contactor FC-tilt)
	F302 - L1 (fuse input) 1 x crimp-type end-splice	F303 - L1 (fuse input) 1 x crimp-type end-splice	Supplies feed through to other fuse outputs
	F304 - L2 (fuse input) 1 x crimp-type end-splice	F305 - L2 (fuse input) 1 x crimp-type end-splice	
	F303 - L1 (fuse input) 1 x crimp-type end-splice	F307 - L1 (fuse input) 1 x crimp-type end-splice	
	F306 - L3 (fuse input) 1 x crimp-type end-splice	F308 - L3 (fuse input) 1 x crimp-type end-splice	

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W302	PSS crimp-type end-splice F307 receptacle X302 (N) ring tongue PE312	COOLING E321, X1 MNL, 3 pos. female	Supply of the dehumidifier one-phase current 230V~ (L1) / I_{fuse}=8A
W303	PSS F301-L1/L2/L3 3 x crimp-type end-splice 1 x ring tongue, M4 at PE305	RTS / ROT_CONV Z302 (filter input) 3 x crimp-type end-splice 1 X ring tongue, M6 For PE	Fuse output to the filter input. Three-phase current supply for the FC-rotation. 400V~ / I_{fuse}=10A
W304	PSS crimp-type end-splice F304 receptacle X302 (N) ring tongue, M4 PE308	COOLING M304 MNL, 3 pos. female	Supply of one of three Gantry fan motors. 230V~ (L2) / I_{fuse}=2A
W305	PSS crimp-type end-splice F305 receptacle X302 (N) ring tongue, M$ PE309	COOLING M305 MNL, 3 pos. female	Supply of one of three Gantry fan motors. 230V~ (L2) / I_{fuse}=2A
W306	PSS crimp-type end-splice F303 receptacle X302 (N) ring tongue PE307	PSS E303, X1 MNL, 3 pos. male	Supply of the AC-DC converter used for the supply of the PCBs inside the stationary part. 230V~ (L1) / I_{fuse}=2A

Table 9-1. **List of Gantry Stationary Cables (Cont)**

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W307	PSS stop contactor output ring tongue, M4, D324 receptacle X302 (N) ring tongue, M4 PE306	RTS TILT_CONTROL Z304 (filter input) 3 x receptacle	Electronic sop contactors to the filter input (Z304).
	1 x ring tongue PE306	RTS TILT_CONTROL E302, X1, PE (power clamp) 1 x crimp-type end-splice	PE - connection of the frequency converter tilt
W308	PSS crimp-type end-splice F306.2 1 x receptacle X302(N) 1 x crimp-type end-splice	Slipring, E420 2 x ring tongue M4	Interruptible supply for the rotating part (mains1) 230 V~ (L3) / I_{fuse}=10 A
W309			reserved
W310	PSS 1 x crimp-type end-splice F308 (L3) 1 x receptacle X302 (N) 1 x ring tongue, M4 PE311	COOLING M306 MNL, 3 pos. female	Supply of one of the three Gantry fan motors. 230 V~ / I_{fuse}=2 A

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W311	PSS E303, X2.1 and .8 MNL, 8 pos. male	MCU_RTC (D301) X10.4 and .11 Sub-D, 15 pos. female	5V supply for sense wire (wired to MCU_RTC)
	PSS E303, X2.4 and .5 MNL, 8 pos. male	PSS F311 (input), X304 2 x receptacle	5 V supply (I_{fuse}=5 A) MCU_RTC (X304 is the common ground connector for the 5 V, 12 V and 24 V supply)
	PSS F311 (output), X304 2 x receptacle	MCU_RTC (D301) X10.2 and .9 Sub-D, 15 pos. female	
	PSS E303, X2.3 and .6 MNL, 8 pos. male	PSS F316 (input), X304 2 x receptacle	5 V supply (I_{fuse}=3 A) NOISE_CAN
	PSS E303, X3.3 and .4 MNL, 6 pos. male	PSS LTV_12V, X304 1 x receptacle	12 v supply MCU_RTC and NOISE_CAN
	PSS LTV_12V	PSS F312 (input) 1 x receptacle	12 V supply (I_{fuse}=3 A) MCU_RTC
	PSS LTV_12V	PSS F317 (input) 1 x receptacle	12 V supply (I_{fuse}=3 A) NOISE_CAN
	PSS E303, X.1 and .2 MNL, 6 pos. male	PSS F313 (input), X304 2 x receptacle	12 V supply (I_{fuse}=3 A) GPC

Table 9-1. **List of Gantry Stationary Cables (Cont)**

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
	PSS F312 (output), X304 2 x receptacle	MCU_RTC (D301) X10.6 and .13 Sub-D, 15 pos. female	12 V supply (I_{fuse}=3 A) MCU_RTC
	PSS E303, X3.5 and .6 MNL, 6 pos. male	PSS LTV_24V, X304 1 x receptacle	24V supply MCU_RTC and GPC
	PSS LTV_24V	PSS F314 (input) 1 x receptacle	24 V supply (I_{fuse}=3 A) MCU_RTC
	PSS F314 (output), X304 2 x receptacle	MCU_RTC (D301) X10.8 an d.15 Sub-D, 15 pos. female	24 V supply (I_{fuse}=3 A) MCU_RTC
	PSS LTV_24V	PSS F315 (input) 1 x receptacle	24 V supply (I_{fuse}=3 A) GPC
W312	RTS / TILT_CONTROL Z304.N’, Z304.L’ (filter output N, L) 2 x receptacle	RTX / TILT_CONTROL E302 / X1.N, X1.L (power clamp) 2 x crimp-type end-splice	Z304 filter output to the tilt frequency converter input. 230 V supply I_{fuse}=10 A
W313	PSS X304, F316 (output) 2 x receptacle	AUDIO_GANTRY D344, X4.2 an d.6 Sub-D, 9 pos male	5V supply (I_{fuse}=3A) NOISE_CAN

Table 9-1. **List of Gantry Stationary Cables (Cont)**

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
	PSS X304, F317 (output) 2 x receptacle	AUDIO_GANTRY (D344) X4 .4 and .8 Sub-D, 9 pos. male	12 V supply (I_{fuse}=3 A) NOISE_CAN
W314	PSS X304, F313 (output) X304, F315 (output) 4 x receptacle	PHC / GPC (D311) X7 MM, 6 pos. female	output of the fuses wired to GPC. (12V and 24V supply)
W315	PSS X303.3. X303.4 X303.1, X303.2 4 x crimp-type end-splice (cable shield on GND)	SLIPRING, E420 X382 (560V DC minus) X383 (560V DC plus) 4 x ring tongue, M6 (cable shield on GND)	560V DC for the rotating generator (power sliprings) **Note:** There are two wires for the positive side and two for the negative of the 560V).
W316	PSS PE301 1 x ring tongue, M6	SLIPRING,E420 PE381 1 x ring tongue, M8	PE for the rotating part via slipring. 35^2
W317	RTS TILT_CONTROL E302, X1.W, .U, .V, PE 4 x crimp-type end-splice (cable shield on GND)	RTS TILT_CONTROL M302.1, .2, .3, PE 4 x ring tongue, M4 (cable shield on GND)	Tilt - frequency converter output to the tilt motor. Three phase current. 230 V~ / I_{max}=6 A
W318	RTS / ROT_CONTROL E301, X1 (FC output) 3 x crimp-type end-splice (cable shield on GND)	RTS / ROT_BRAKE E322, L1 (input) 3 x crimp-type end-splice (cable shield on GND)	Rot. - frequency converter output to the reactance coil at the rotation brake assembly. 3-phase current. 400 V ~ / I_{max}=13 A
W319			reserved

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W320	RTS ROT_CONTROL Z302 (line filter output) 3 x crimp-type end-splice (L1, L2, L3) 1 x ring tongue, M6 for PE (cable shield n.c.)	RTS ROT_CONTROL E301 (FC supply) 4 x crimp-type end-splice (L1, L2, L3, PE) (cable shield on GND)	Line-filter output (Z302) to Rot. - frequency converter input. 3-phase current. 400 V ~ / I_{max}=13 A
W321	PSS X304.4 1 x ring tongue	PSS GND301 1 x ring tongue, M6	X304, the common ground connector for the 5V, 12V and 24V supply, wired to PE

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W322	PE315 ring tongue, M5	PE332 ring tongue, M6	Summary of PE wirings. Ring tongues with different diameters.
	PE321 ring tongue, M4	PE322 ring tongue, M4	
	PE374 ring tongue, M6	PE375 ring tongue, M4	
	PE376 ring tongue, M4	PE377 ring tongue, M4	
	PE378 ring tongue, M4	PE379 ring tongue, M4	
	PE370 ring tongue, M8	PE371 ring tongue, M4	
	PE372 ring tongue, M8	PE373 ring tongue, M4	
	PE341 ring tongue, M4	PE342 ring tongue, M4	
	PE336 ring tongue, M4	PE351 ring tongue, M4	
	PE335 ring tongue, M6	PE322 ring tongue, M6	
	PE302 ring tongue, M5	Z301.1.PE.LINE ring tongue, M6	

Table 9-1. **List of Gantry Stationary Cables (Cont)**

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W323	PSS X305 MNL, 3 pos. male	PSS Z305.L, .N, .PE 3 x receptacle	Uninterruptible supply for the rotating part (mains 2) 230 V~ / I_{fuse}=6 A
W324			reserved
W325			reserved
W326	PSS Z305.L, .N 2 x receptacle	SLIPRING, E420 X373 (L), X374 (N) 2 X ring tongue, M4	Output of the one-phase line filter (mains2) 230 V~ / I_{fuse}=6 A
W327	PE310 ring tongue, M4	PE319 PE320	Grounding of connector housings X310 and X311
W351	MCU_RTC (D301) X3 Sub-D, 9 pos. female cable shield connected to housing	PHC GPC (D311) X4 Sub-D, 9 pos. female cable shield connected to housing	GPC - Control (CAN, StopRep, GanDoorSw, Xray)
W352	PHC GPC (D311) X1 Sub-D, 15 pos. female cable shield connected to housing	PHC KEY1 (E351) X1 Sub-D, 15 pos. male cable shield connected to housing	KEY1 - Data & Supply (serial interface, reset, 12V supply)

Table 9-1. **List of Gantry Stationary Cables (Cont)**

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W353	PHC GPC (D311) X2 Sub-D, 15 pos. female cable shield connected to housing	PHC KEY2 (E352) X1 Sub-D, 15 pos. male cable shield connected to housing	KEY2 - Data & Supply (serial interface, reset, 12V supply)
W354	PHC GPC (D311) X3 Sub-D, 9 pos. female cable shield connected to housing	PHC LIMA (E353) D2, X3 MODUIV, 5 pos. female cable shield at GND	Supply for the stationary cross shape light marker (there are three light marker units in the stationary part).
		RTS GantryDoorSw LTV S304, COM 1 x receptacle cable shield at GND	Two gantry door switches series - connected
	RTS / GantryDoorSw S304.NO, LTV 1 x receptacle cable shield at GND	RTS GantryDoorSw S305.COM, S305.NO 2 x receptacle cable shield at GND	
W355	AUDIO GANTRY NOISE_CAN D344, X3 Sub-D, 9 pos. male cable shield connected to housing	AUDIO GANTRY X325 Sub-D, 15 pos. female cable shield connected to housing	Signals for the two microphones, the loudspeaker and the supply for MIC-GAN. (Point B: Interconnector at the Gantry funnel - continued within W382)

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W356	PHC GPC (D311) X6 MM, 9 pos. female	AUDIO GANTRY X312 MM, 6 pos. female	Control of the respiration lamp, 24V (continued with W381)
	PE333 ring tongue, M6		
W357	MCU_RTC (D301) X18 Sub-D, 15 pos.female cable shield connected to housing	PSS Pin 3 and 4 of the stop contactor D324 8 x ring tongue, M4	Control of stop contactors for tilt
		RTS Tilt_Control E302.X1 8 x crimp-type end-splice cable shield at GND	Control of the frequency converter for Tilt (comm. and HW control)
W358	MCU_RTC (D301) X11 Sub-D, 9 pos. female	Gantry Footswitch1 X313 Cannon, circular 3 pos. wire-endings tin-plated	Wirings to the plugs to a footswitch for X-ray release connector type: female, XLR-3-31
W360	MCU_RTC (D301) X24 Sub-D, 15 pos. female	Gantry, PULMO unit X1, Sub-D, 9 pos. female	Wiring to the interconnector for the PULMO-option, including: 5V and 24V supply.
W361	MCU_RTC (D301) X25 Sub-D, 9 pos. female	Gantry Power Injector X310 Binder, circular, 8 pos. wire-endings tin-plated	Wiring to the interconnector for the Power-injector option; connector type: 09--474-00-08

Table 9-1. **List of Gantry Stationary Cables (Cont)**

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W362	MCU_RTC (D301) X9 Sub-D, 15 pos. female cable shield connected to housing	RTS ROT_CONTROL E301, X322 Sub-D, 15 pos. female cable shield connected to housing	Control of the frequency converter for rotation. (Comm. and HW Control, 24 V, StopRep)
W363	MCU_RTC (D301) X7 Sub-D, 9 pos. female cable shield connected to housing	RTS Tilt sensor (B301), X1 Sub-D, 9 pos. female cable shield connected to housing	Tilt sensor supply (12V) and control
W364	MCU_RTC (D301) X2 Sub-D, 15 pos. female cable shield connected to housing	SLIPRING, E400 X341 ... X348 8 x ring tongue, M3	CAN-Comm (345, 346), stop report (347, 348), control data-SR (341, 342), control data-RS (343, 344), X341 : inner ring X348 : outer ring
W365	MCU_RTC (D301) X17 Sub-D, 15 pos. female	RTS tilt motor M302.9, .6, .5, .7 4 x ring tongue, M4	Tilt motor brake (inside the motor) and overtemperature switch. 24 V= / I_{max}=3 A
		RTS M302.Y2+, M302.Y2- wire endings tin-plated	Gantry tilt motor brake mounted at the motor axis. 24 V= / I_{max}=3 A
W366	MCU_RTC (D301) X21 Sub-D, 9 pos. female	Tape Switch	Series connected switches inside of the gantry funnel. ***Short circuit connector required, as function is not used.***
		Scan time counter	Trigger pulses for a scan time counter.

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W367	MCU_RTC (D301) X19 Sub-D, 15 pos. female cable shield connected to housing.	COOLING sensor B302 2 x crimp-type end-splices	Monitoring of temperature and humidity inside of gantry.
W368	MCU_RTC (D301) X12 Sub-D, 9 pos. female cable shield connected to housing.	AUDIO GANTRY NOISE_CAN (D344) X1 Sub-D, 9 pos. female cable shield connected to housing.	Signals for noise cancellation and intercom.
W369	MCU_RTC (D301) X20 Sub-D, 15 pos. female	COOLING E321, X2.2 and .6 Sub-D, 9 pos. female	Control of the dehumidifier (24V signal for switching ON)
		COOLING MV1 Metri-Mate, 4 pos. female	Control of the mixer valve
W370	Gantry, PULMO unit X2 Sub-D, 9 pos. male	Gantry X311 Binder, circular, 12 pos. wire endings tin-plated	Wiring from the PULMO option to the interconnector for the Spirometer. Connector type: 09-0332-00-12

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W373	RTS ROT_CONTROL X322 Sub-D, 15 pos. male	RTS ROT_CONTROL E301, X2 5 x crimp-type end-splice	HW-Control of FC (special connector inside of the FC)
		RTS ROT_CONTROL E301, X42 4 x crimp-type end-splice	Serial I/O (RS485) to the FC and 24V supply for the FC-SIO
		RTS ROT_CONTROL X323 Sub-D, 9 pos. male	StopReport wiring to the STOP buttons located on the left and right side of the gantry.
		RTS ROT_SW S301.1 and .3 2 x crimp-type end-splice	Wiring to the rotation OFF switch (two NO-contacts)
	RTS ROT_BRAKE E322, X2 Sib-D, 9 pos. female	RTS ROT_SW S301.2 and .4 2 x crimp-type end-splice	Wiring from the rotation OFF switch (two COM contacts) to the rotation brake assembly. I*f S301 is off, the FC disconnects from the motor via contactors on the rotation brake assembly.*
W374	RTS ROT_CONTROL X323 Sub-D, 9 pos. female cable shield connected to housing	RTS S302 : COM, NC S303 : COM, NC 4 x receptacle cable shield on GND	STOP buttons located on the left and right side of the gantry. (StopReport - current loop)

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W375	MCU_RTC (D301) X22 SMB - type connector	DATA SLIPRING, E400, X1 SMB - type connector	12V power supply for the data slipring interface (coaxial wire)
W376	PSS X321 ST - type connector	DATA SLIPRING E400, X2 ST - type connector	Intermediate connector for the imager data path (fiber optic 62.5mm) (length = 5m)
W377	PHC LIMA (E353) D2, X4 MODUIV 5 pos. female cable shield on GND	PHC LIMA (E354) D2, X3 MODUIV 5 pos. female cable shield on GND	Supply for the stationary line shape light marker (there are three light marker units in the stationary part)
W378	PHC LIMA (E354) D2, X4 MODUIV 5 pos. female cable shield on GND	PHC LIMA (E355) D2, X3 MODUIV 5 pos. female cable shield on GND	Supply for the stationary line shape light marker (there are three light marker units in the stationary part).
W381	AUTIO GANTRY X312 MM, 6 pos. male	AUDIO GANTRY H301.1 and .2 soldered on lead	Respiration lamp in the gantry funnel. (feed through from GPC)
		AUDIO GANTRY PE361 ring tongue, M4	

Table 9-1. List of Gantry Stationary Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W382	AUDIO GANTRY X325 Sub-D, 15 pos. male cable shield connected to housing	AUDIO GANTRY MIC-GAN (D342) X1 Sub-D, 9 pos. female cable shield connected to housing	Signals for the two microphones, the loudspeaker and the supply for the MIC-GAN. *(Point A: interconnector to the gantry funnel).*
W383	AUDIO GANTRY MIC-GAN (D342) X40, X41, X42 cable shield on GND	AUDIO GANTRY MICROPHONE B311 cable shield on GND	Microphone in the gantry funnel, (wiring is a part of the microphone)
W384	AUDIO GANTRY MIC-GAN (D342) X50, X51, X52 cable shield on GND	AUDIO GANTRY MICROPHONE B312 cable shield on GND	Microphone in the gantry funnel, (wiring is a part of the microphone).
W385	AUDIO GANTRY MIC-GAN (D342) X30, X31	AUDIO GANTRY LOUDSPEAKER B313 wire endings tin-plated	Loudspeaker in the gantry funnel.
W390	PSS X314 MNL, 4 pos. male	COOLING B305 wire endings tin plated.	Overtemperature switch in the gantry (monitored by PDC via W1)
		PSS S309 / NO. COM 2 x receptacle	Slipring power OFF switch located on the rear gantry cover. (If opened, voltage is switched away from the sliprings via PDC).

Gantry Rotating Cabling

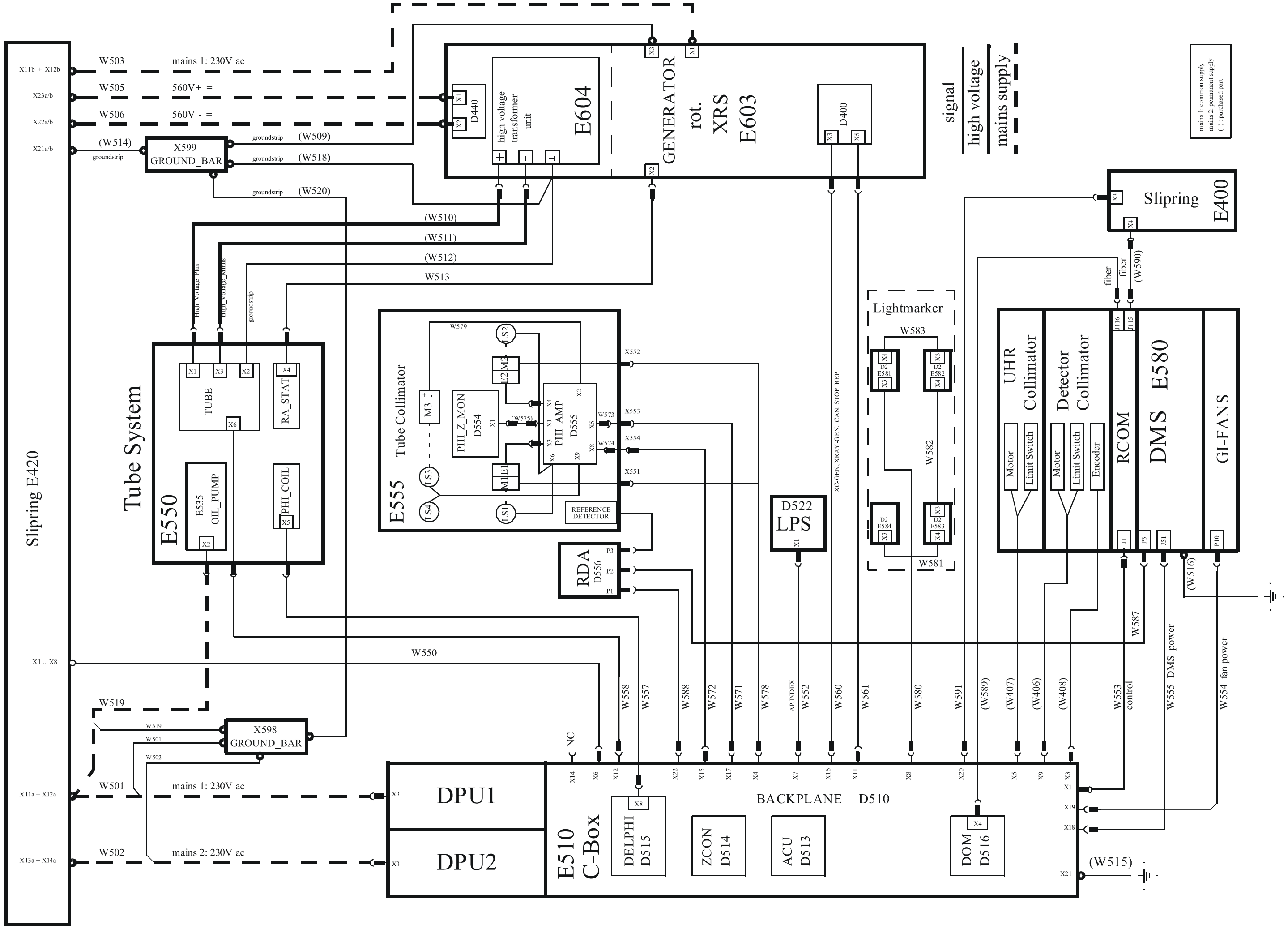

Slipring E420
X11b + X12b
X23a/b
X22a/b
X21a/b
X1 ... X8
X11a + X12a
X13a + X14a
W503
mains 1: 230V ac
W505
560V+ =
W506
560V - =
(W514)
groundstrip
X599
GROUND_BAR
groundstrip
(W509)
groundstrip
(W518)
groundstrip
(W520)
D440
X1
X2
high voltage
transformer
unit
E604
GENERATOR
rot.
XRS
E603
X3
X1
X2
D400
X1
X5
signal
high voltage
mains supply
mains 1: common supply
mains 2: permanent supply
( ) : purchased part
(W510)
(W511)
(W512)
W513
High_Voltage_Plus
High_Voltage_Minus
groundstrip
Slipring
E400
X3
X4
fiber
fiber
(W590)
Tube System
E550
TUBE
X1
X3
X2
X6
X4
RA_STAT
E535
OIL_PUMP
X2
PHI_COIL
X5
Tube Collimator
E555
W579
LS2
E2 M2
M3
PHI_Z_MON
D554
X1
(W575)
PHI_AMP
D555
X4
X1
X3
X6
X2
X5
X8
X9
W573
W574
LS3
LS4
M1 E1
LS1
REFERENCE
DETECTOR
X552
X553
X554
X551
RDA
D556
P3
P2
P1
D522
LPS
X1
XC-GEN, XRAY-GEN, CAN, STOP_REP
Lightmarker
W583
X4
D2
E581
X3
X3
D2
E582
X4
W582
D2
E584
X3
X3
D2
E583
X4
W581
UHR
Collimator
Motor
Limit Switch
Detector
Collimator
Motor
Limit Switch
Encoder
RCOM
DMS E580
GI-FANS
J116
J115
J1
P3
J51
P10
(W516)
W587
W555 DMS power
W554 fan power
W553
control
W550
W519
W519
W501
W502
X598
GROUND_BAR
W501
mains 1: 230V ac
W502
mains 2: 230V ac
X3
DPU1
X3
DPU2
NC
W558
W557
W588
W572
W571
W578
AP,INDEX
W552
W560
W561
W580
W591
(W589)
(W407)
(W406)
(W408)
X14
X6
X12
X22
X15
X17
X4
X7
X16
X11
X8
X20
X5
X9
X3
X1
X19
X18
X21
BACKPLANE D510
E510
C-Box
X8
DELPHI
D515
ZCON
D514
ACU
D513
X4
DOM
D516
(W515)

Figure 9-37: Gantry Rotating Cabling Layout

Gantry Rotating Cabling List

Table 9-4: List of Gantry Rotating Cables

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W406	C_BOX, E510 D520, X9 Sub-D, 9 pos. male	Detector collimator optical P-1 AMP MODU, 5 pos. female	DC motor power and limit switches.
W407	C_BOX, E510 D510, X5 Sub-D, 9 pos. male	UHR Collimator (Comb) optical P-1 AMP MODU, 5 pos. female	DC motor power and limit switches.
W501	C_BOX, E510 CPU1 X3 MNL, 3 pos. female	Power slipring, E420 X11a, X12a ring tongue, M4	Power supply (mains 1) for gantry rot control 230V~ / 10A
		Drum Ground_bar, X598 ring tongue, M4	
W502	C_BOX, E510 DPU2 X3 MNL, 3 pos. female	Power slipring, E420 X13a, X14a ring tongue, M4	Power supply (mains 2) for DMS 230V~ / 10A
		Drum Ground_bar, X598 ring tongue, M4	
W503	Power slipring, E420 X11b, X12b Ground_bar, X599 ring tongue	Generator, rot. E603.X1 MNL, 3 pos. female	Power supply (main 1) for Generator, rot. 230V~ / 10A

Table 9-4: List of Gantry Rotating Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W504			reserved
W505	Power slipring, E420 X23a, X23b ring tongue, M5	Generator, rot., E603 D440, X1 ring tongue, M6	560V DC plus 250 A_{peak} 2 x 16^2
W506	Power slipring, E420 X22a, X22b ring tongue, M5	Generator, rot., E603 D440, X2 ring tongue, M6	560V DC minus 250 A_{peak} 2 x 16^2
W507			reserved
W508			reserved
W509	Drum Ground_bar X599 ring tongue, M6	Generator, rot. E603, X3 ring tongue, M6	GND_ROT (system ground) ground strip
W510	Generator, rot. E604, X1 HV O-connector	X-ray tube E550, X1	High voltage - plus
W511	Generator, rot. E604, X2 HV O-connector	S-ray tube E550, X3	High voltage - minus
W512	Generator, rot. E604, GND ring tongue, M6	X-ray tube E550, X2 ring tongue, M6	Ground strip

Table 9-4: List of Gantry Rotating Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W513	Generator, rot. E603, X2 Wieland GST18/4, 4 pos., female	X-ray tube E550, X4 LemoSA, 3 pos. male	Rotating Anode Drive
W514	Power slipring, E420 X21a, X21b ring tongue, M5	Drum Ground_bar X599 ring tongue, M6	GND_ROT (system ground) Ground strip
W515	C_BOX D510, X100 ring tongue	Drum Ground_bar X598 ring tongue, M6	GND_ROT (system ground) Ground strip
W516	Tube Collimator, E555 GND ring tongue, M6	Drum Ground_bar X598 ring tongue, M6	GND_ROT (system ground) Ground strip
W517			reserved
W518	Drum Ground_bar X599 ring tongue, M6	Generator, rot. E604, GND ring tongue, M6	GND_ROT (system ground) Ground strip

Table 9-4: List of Gantry Rotating Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W519	X-ray tube oil pump E535, X2 MNL series rt, CuZn/Sn 4 pos. female	Slipring, E420 X11a, X12a ring tongue, M4	Power supply (mains 1) for oil pump, 150 VA 230V~ / 10A
		Drum Ground_bar X598 ring tongue, M6	
W520	Drum Ground_bar X598 ring tongue, M6	Drum Ground_bar X599 ring tongue, M6	GND_ROT (system ground) Ground strip
W550	C_BOX, E510 D510, x6 Sub-D, 15 pos. female	Slipring, E420 X1 ... X8 ring tongue, M3	Control data X1 : inner ring X8 : outer ring
W551			reserved
W552	C_BOX, E510 D510, X7 Sub-D, 9 pos. male	LPS D522, X1 Sub-D, 9 pos. female	Slot ring data
W553	C_BOX, E510 D510, X1 Sub-D, 25 pos. female	DMS RCOM, J1 Sub-D, 25 pos. male	Control data for FEE and RCOM

Table 9-4: List of Gantry Rotating Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W554	C_BOX, E510 D510, X19 Sub-D, 15 pos. male	DMS, fans P10 Sub-D, 15 pos. female	GI fan power, 24V= monitoring of DMS temperature
W555	C_BOX, E510 D510, X18 Sub-D, high power male	DMS E580, J51 Sub-D, high power female	DMS power
W556	C_BOX, E510 D510, X14 Sub-D, 9 pos. male	C_Box Fan J1	Fan power for C_BOX 24V= (option)
W557	C_BOX, E510 D515, X8 Sub-D, 9 pos. male	X-ray tube E550, X5 LemoSA/ODU 4 pos. male	Deflection coil (phi) 38V / 2.5A_{eff}
W558	C_BOX, E510 D510, X12 Sub-D, 9 pos. male	X-ray tube E550, X6 LemoSA/ODU, 10 pos. .1, .2, .3, .4, .9 male .5, .8, 10 female 4 pos. male	Tube monitoring signals
W560	C_BOX, E510 D510, X16 Sub-D, 9 pos. male	Generator rot., E603 D400, X3 Sub-D, 9 pos. female	Digital control (CAN, StopRep)

Table 9-4: List of Gantry Rotating Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W561	C_BOX, E510 D510, X11 Sub-D, 9 pos. male	Generator rot., E603 D400, X5 Sub-D, 9 pos. female	Analog and digital control
W571	C_BOX, E510 D510, X17 Sub-D, 25 pos. male	Tube collimator E555, X553 Sub-D, 25 pos. female	Phi_amplifier (analog / power)
W572	C_BOX, E510 D510, X15 Sub-D, 37 pos. female	Tube collimator E555, X554 Sub-D, 37 pos. male	Control signals for tube collimator (digital)
W573	Tube collimator, E555 X553 Sub-D, 25 pos. male	PHI_AMP E555, D555, X5 Sub-D, 25 pos. female	Phi_amplifier (analog / power)
W574	Tube collimator, E555 X554 Sub-D, 37 pos. female	PHI_AMP E555, D555, X8 Sub-D, 37 pos. male	Control signals for tube collimator (digital)
W575	PHI_Z_MON E555, D554, X1 male	PHI_AMP E555, D555, X1 male	Phi-/Z-monitor signals (analog) flat cable
W576			reserved
W577			reserved

Table 9-4: List of Gantry Rotating Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W578	C_BOX, E510 D510, X4 Sub-D, 15 pos. male	Tube collimator, E555 X551 & X552 Sub-D, 9 pos. female	Tube collimator motor M1 and M2 24V / 1Amax
W579	Tube collimator, E555 D555, X2.1 / X2.2 FASTON	Tube collimator, E555 compensation motor M3 2 pos. soldered on lead	Compensator motor 24V / 1A
W580	C_BOX, E510 D510, X8 Sub-D, 9 pos. male	E584 D2, X2 AMP MOD IV, 5 pos. female	Light marker, 1 rot.
W581	E583 D2, X4 AMP MODI IV, 5 pos. female	E584 D2, X3 AMP MOD IV, 5 pos. female	Light marker, 2 rot.
W582	E582 D2, X4 AMP MOD IV, 5 pos. female	E584 D2, X4 AMP MOD IV, 5 pos. female	Light marker, 3 rot.
W583	E581 D2, X2 AMP MOD IV, 5 pos. female	E582 D2, X3 AMP MOD IV, 5 pos. female	Light marker, 4 rot.

Table 9-4: List of Gantry Rotating Cables (Cont)

CABLE	POINT A	POINT B	FUNCTION/SPECIFICATION
W587	DMS, E580 P3 SMB female	RDA, D556 P2, SMB female	Amplified dose monitor signal (reference detector)
W588	C_BOX, E510 D510, X22 Sub-D, 9 pos. male	RDA, D556 P1 Sub-D, 9 pos. female	DC power for RDA (**R**eference **D**etector **A**mplifier)
W589	DMS, E580 RCOM, J116 ST male	C_BOX, E510 D516, X4 ST male	Measurement date for DOM fiber length = 2m
W590	DMS, E580 RCOM, J115 ST male	Data slipring, E400 X4 ST male	Measurement data fiber length = 2m
W591	C_BOX, E510 D510, X20 SMB female	Data slipring, E400 X3 SMB female	Power for slipring 15V = / 0.3A

Ground Rules

Overview

Adhere to the following rules when connecting system cables and wires.

1. All shields at stationary parts should be connected to PE (Protective Earth).
2. All shields at rotating parts should be connected to drum (system ground, X599).
3. Returns of power supply voltages should be connected to one single point within each component (Gantry Stationary, Gantry Rotating, Computer Rack, Patient Table).
4. Data cables should be shielded and twisted in pairs. For example, pins 2/6, 3/7, 4/8, 5/9 for a plug with 9 positions.

High Voltage Circuit

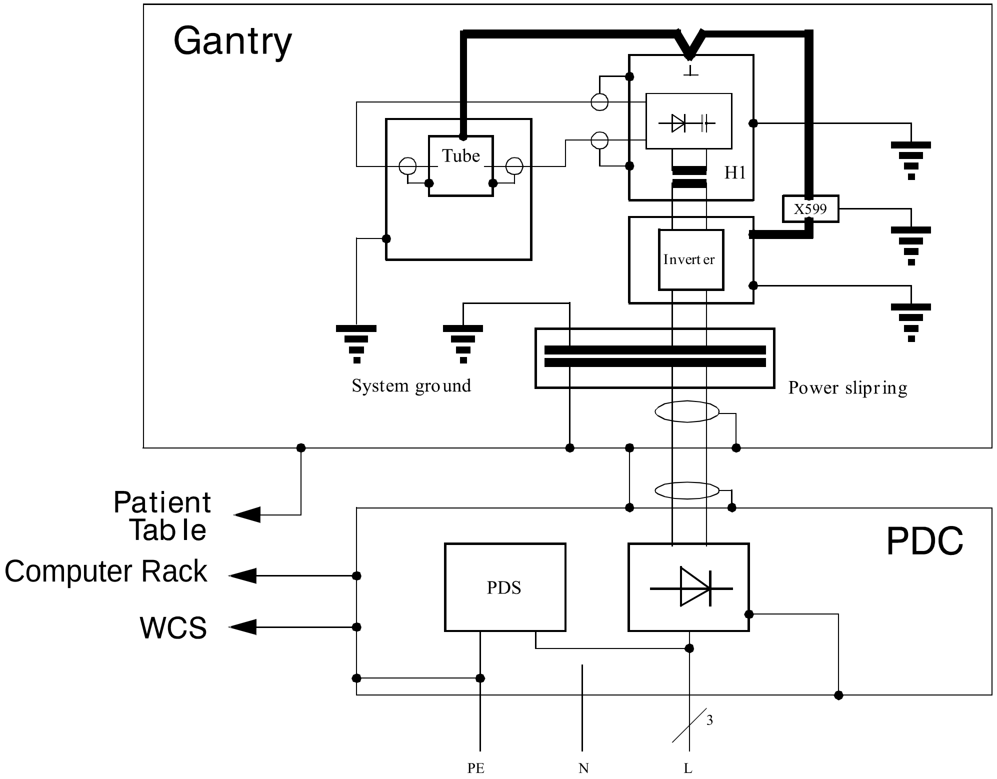

Gantry
Tube
H1
X599
Inverter
System ground
Power slipring
Patient
Table
Computer Rack
WCS
PDC
PDS
3
PE
N
L

Figure 9-38: Principle of Ground Wiring of High Voltage Circuit

CAN Bus Wiring

Adhere to the following instructions when connecting the CAN bus wires:

1. Bus termination (approximately 51W) is done at the following locations:
    - D451 inside PDC (180W)
    - D30 (CIB) inside ICS (180W)

- XRS on Gantry Rotating (120W)

2. Returns of DC/DC converter outputs should be floating, except for MCU_RTC.

Chapter 10
System Options

AMC-4 Option 10-1

Installing the AMC Device (AMC-4 Option) 10-1
- Location 10-1
- Power Supply 10-1
- Connecting the Cables 10-2
- LED Indicators 10-5
- Internal Jumper Configuration 10-6
- Declaring the AMC-4 as an Mx8000 Device 10-7
- Testing The AMC 10-7

CEXT Option 10-9

- Parts 10-10
- Tools 10-13
- Estimated Time 10-13

Installation Procedure 10-13
- Removing the W865 Cable from the Rack 10-13
- Removing the W865 Cable from the Console 10-16
- Installing the W870 Cable 10-18

Cardiac Prospective Gating 10-19

Prerequisite 10-19
Parts 10-20
Tools 10-20
Estimated Time 10-20
Setting Up the ECG Unit 10-21
- ECG Monitor Battery 10-21
- Voltage Supply 10-21

Final Steps 10-24

CCT Site Preparation 10-25

Safety Notes 10-26
Site Preparation Prerequisites 10-27
- Ceiling Height: 10-27

Support Column Positioning 10-28
- For Existing Mx8000 Systems 10-28
- For Mx8000 Systems Not Yet Installed 10-29

Structural Details 10-30
Seismic Anchorage With Ceiling Plate 10-31
Load Calculation: Ceiling—Mounting Plate 10-32
Cable Ducts and Routing 10-34

CCT Installation 10-35

Tools Required 10-35
Estimated Time 10-35
Preface 10-35
Prerequisite 10-36
Parts 10-36
Assembly Procedure 10-38
    Server Base Assembly 10-38
    Server Base Mounting 10-40
Footswitch Installation 10-42
    Installation 10-42
Overhead Monitor Option 10-43
    Monitor Arm Assembly 10-43
    Monitor Cable Connections 10-45
Cart Monitor Option 10-47
    Cart Assembly 10-47
Final Checks 10-50
Troubleshooting 10-51

IRS Upgrade to 24 SHARCS 10-52

General 10-52
Parts 10-52
Tools 10-53
Estimated Time 10-53
IRS Installation Procedure 10-53
    System Setup 10-53
    Setting the Expansion Cards to 16 MB Window Size 10-58
Post Programming Procedure 10-60
    PCI Link Card 10-62

MEM-8 Option 10-64

Parts 10-64
Installation Instructions 10-65
    O2 Memory Banks - General Description 10-65
    Installation Procedure 10-66

21" Remote Slave Monitor Option 10-67

Safety Information 10-67
Precautionary Measures Regarding Electrical Voltage 10-67
Tool Required 10-68
Estimated Time and Manpower 10-68
Preface 10-69
Parts 10-69
Video Amplifier Assembly 10-71
Assembly Procedure 10-71
Remote Slave Monitor Assembly 10-75

UPS (Uninterruptible Power Supply) Option 10-76

Parts 10-76
Tools 10-77
Estimated Time 10-77
Procedure 10-77
Tests 10-79

SAS (Spiral Auto Start) 10-80

Prerequisites 10-81
Tools 10-84
Time 10-84
Parts 10-84
Procedure 10-85
Connection of External Cable MCU/RTC X25 to the Injector 10-85
Medrad Envision Injector Test 10-87
Test Objectives 10-87
Test Plan 10-87
CANpro Verification 10-87
Medrad Visitron Injector Test 10-88
Test Objectives 10-88
AutoLink Test 10-88
Test Plan 10-88
CANpro Verification 10-89
Liebel Florsheim CT9000 ADV Injector Test 10-90
Test Objectives 10-90
Test Plan 10-90
CANpro Verification 10-90
Liebel Florsheim Angomat Injector Test 10-91
Test Objectives 10-91
Test Plan 10-91
CANpro Verification 10-91
Injector Cable and Wiring Diagrams 10-92

AMC-4 Option

Installing the AMC Device (AMC-4 Option)

The AMC package is an interface providing connectivity between the Mx8000 workstation and a Laser Multi Imager (LMI) of various manufactures, such as 3M, Kodak, Agfa and Dupont. The AMC device is connected to the Mx8000 workstation through the parallel and serial ports.

The AMC connection to the imager is based on the 3M digital data communication protocol (RS-422). The AMC device has a parallel port output for connecting the workstation to peripheral devices, such as a local Centronics printer. The AMC package includes the AMC device and all necessary cables.

Location

Place AMC device in the computer rack of the Mx8000 system.

Power Supply

The AMC device features a universal power supply accommodating input voltage in the 85-250 V range.

The AMC device has a fuse located in the fuse compartment adjacent to the ON/OFF switch. If the **PWR** LED is not ON when the AMC is powered, replace the fuse. Use the spare fuse inside the fuse compartment.

To replace the fuse:

1. Disconnect the power cable from the AMC.
2. Using a screwdriver or fingernail, pull out the fuse compartment by releasing the holder.
3. Replace the fuse with the spare fuse (PN F_00055000M).
4. Return the fuse compartment to its place.

Connecting the Cables

Figure 10-1 illustrates the AMC cabling.

> **NOTE:**
>
> The connection to the printer (cable number 7) is optional.
> Cable number 8 (LMI 952 SERIAL CABLE) is used only with the 3M 952 LMI. In this case, change the position of the internal jumper. For the 3M model, cable number 4 (F.S. OUT) is not used.
> Operation from a footswitch is not yet supported, however it is recommended to connect the footswitch to the LMI.

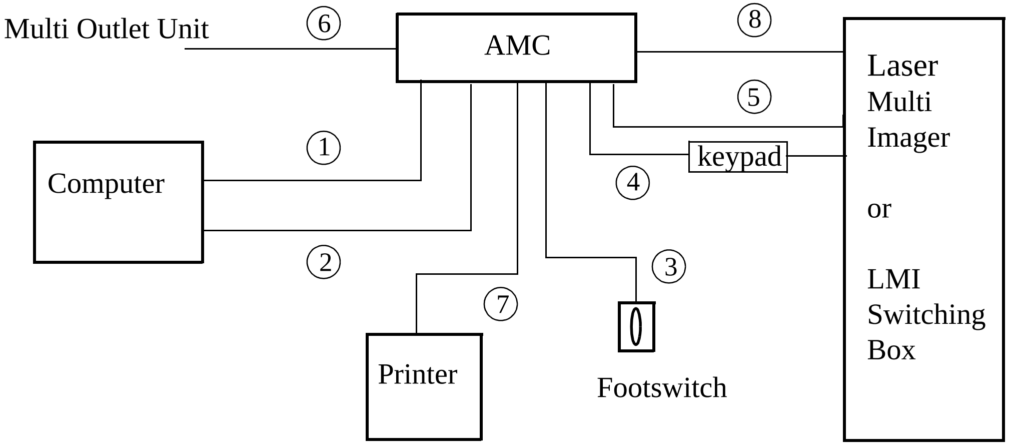

Multi Outlet Unit
⑥
AMC
⑧
Laser
Multi
Imager
or
LMI
Switching
Box
⑤
①
keypad
④
Computer
②
③
⑦
Printer
Footswitch

Figure 10-1: AMC Cabling Diagram

Table 10-1 specifies the cables in use. Cable 7 is not supplied. Use the cable supplied with the printer. The cable numbers correspond to the numbers in *Figure 10-1*.

Table 10-1: AMC Cables

CABLE NO.	CABLE NAME	LENGTH	PHILIPS P/N
1[1]	Host Parallel Cable	2.1 m	475-7169-1709
2[1]	Host Serial Cable	2.1 m	475-7169-1808
3[2]	F.S. IN 3M Cable F.S. IN Kodak Cable F.S. IN DUP/AGFA Cable	0.3 m 0.3 m 0.3 m	475-7169-0602 475-7169-0909 475-7169-1195
4[2]	F.S. OUT 3M CABLE F.S. OUT Kodak Cable F.S. OUT DUP/AGFA Cable	3.0 m 2.5 m 2.5 m	475-7169-0503 475-7169-0800 475-7169-1006
5	LMI Parallel Cable	16.0 m	475-7169-0206
6[3]	Power Cable (110 V, US Standard) Power Cable (220 V, IEC 320 Standard)	2.3 m 3.0 m	IC00270025M IC002601053
8[4]	LMI 952 Serial Cable	16.0 m	475-7169-1600

1. *Use cables compatible with the Mx8000 computer.*
2. *The cables are supplied for various imagers, including 3M, Kodak, Dupont, AGFA.*
3. *Use a cable compatible with your local power regulations.*
4. *Used only with the 3M 952 or 3M 959 LMI.*

Connect the cables according as shown in *Table 10-1* (cable numbers correspond to *Figure 10-1*).

Table 10-2: AMC Cable Connections

CABLE NO.	AMC CONNECTOR NAME	OPPOSITE SIDE CONNECTION
1	AMC P Host (J1A)	Computer parallel output
2	AMC S Host (J2B)	Computer serial port 2
3[1]	FTSW IN (J4A)	Footswitch connector
4	FTSW OUT (J4B)	LMI Footswitch in connector
5	AMC P LMI (J3)	LMI parallel data in connector
6	Power Connector	Multi outlet power strip
7	AMC Printer (J1B)	Printer connector
8[2]	AMC S LMI (J2A)	LMI RS422 Host Control Connector

[1] *A BNC, double-ended, female coupler (supplied with the AMC cable kit) is required for connecting the F.S. IN 3M cable to the footswitch cable.*

[2] *This cable replaces the keypad of the LMI.*

LED Indicators

The AMC features four LED indicators for reporting status and activity. The **Xfer** LED is located on the front panel, while the other three are located on the rear panel. *Table 10-3* describes the LED functions under different conditions.

Table 10-3: LED Indications

LED	INDICATION
Xfer	ON - The AMC is in image transfer mode. OFF - The AMC is in idle mode.
PWR	ON - Power switch on, power applied to AMC. OFF - Power switch off or no power applied to AMC.
TX	BLINK - Data is sent to the LMI. OFF - No data is sent to the LMI.
RX	BLINK - Data is received from the workstation. OFF - No data is received from the workstation.

Internal Jumper Configuration

The AMC Board has an internal jumper. When this jumper is set to its default position (HOST), the AMC is compatible with all types of LMIs, excluding the 3M 952 Model.

To connect a 3M 952 or 3M 959 LMI you need to change the position of the internal jumper.

⚠ CAUTION

TO PREVENT ELECTRIC SHOCK, SWITCH OFF THE AMC POWER SWITCH, AND DISCONNECT THE POWER CABLE BEFORE ATTEMPTING TO REMOVE THE COVER.

To change the position of the internal jumper, do the following:

1. Remove the AMC cover by releasing four screws located at the sides of the box.
2. Change the position of the OJW1 jumper from HOST position (default) to LMI position (see *Figure 10-2)*.
3. Replace the AMC cover.
4. Reconnect the power cable.

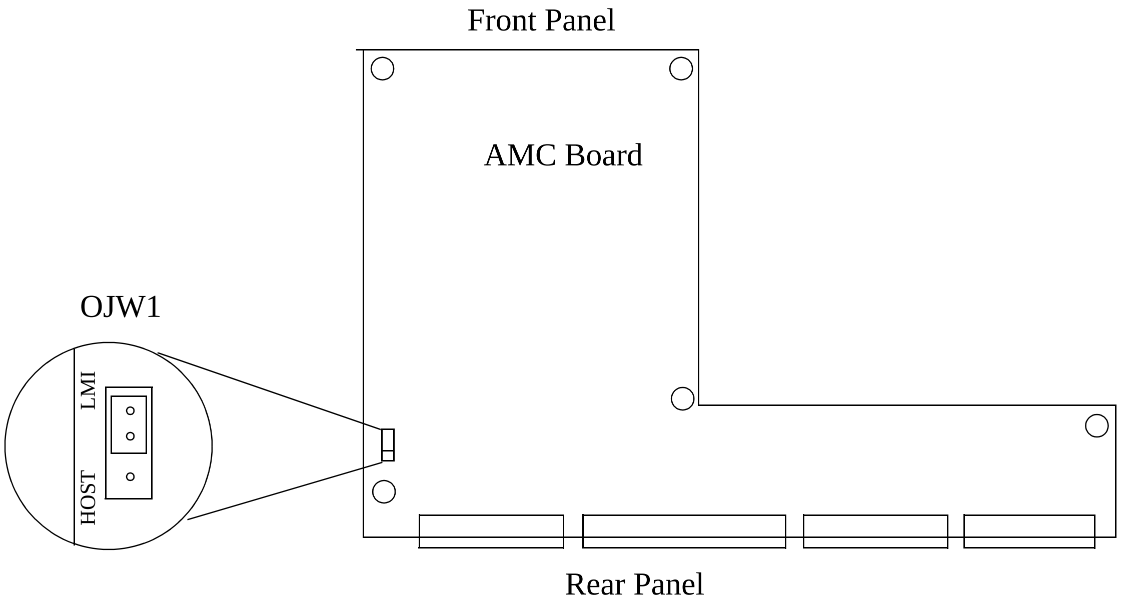


Figure 10-2: OJW1 Jumper Position

Declaring the AMC-4 as an Mx8000 Device

See *"Mx8000 Network Configuration"*.

Testing The AMC

To verify that the AMC is installed properly, see *"AMC Confidence Tests"*.

If one of the tests fails - for example, images are not transferred to the LMI - see *"Printing Problems - AMC (Laser Multi Imager Interface) Not Working"*.

Test the AMC using the MasterFilm task, as follows:

1. Login as **config**. (Use password: **config95**).
2. Declare the AMC as the system device.
3. After the system reboots, turn ON the AMC.

> **NOTE:**
>
> The AMC may be turned ON and OFF regardless of the system's power state. Usually, it should be ON at all times.

4. Login as **Mx8000**.
5. Click **Tasks** (at the right of the Menu Bar).
6. Activate the **MasterFilm** Application.
7. Click **File** and add images.
8. Select a study or a part of it, and click **OK**. The images are loaded to the film Previewer.
9. Select the desired film format (matrix) on the LMI keypad.
10. Select the same film format by clicking the icon and typing in the number of rows and columns.

11. Click the **Printer** icon, and choose to film one page. Click **OK**.
    If the AMC is properly installed, printing starts.
12. Check that the film is free of artifacts and identical to the source image.

Troubleshooting Tips

If you have problems such as: error messages or films not printed, check the following:

- Power cord is connected to the AMC, and the red Power LED is lit.
- Parallel Host cable is properly connected on both ends.
- Serial Host cable is properly connected on both ends.
- The AMC is declared as a device of the Mx8000 system.

Turn the MxView and the AMC OFF, then turn them ON.

CEXT Option

The CEXT option provides longer cables when the Computer Rack must be on the left side of the Console (as viewed from the front of the Console) and more than two meters from it, or when the Computer Rack must be on the right side of the Console and more than a half meter from it.

The basic system includes a five meter cable to connect the Computer Rack and the Console. Of that five meters, approximately three meters lay inside the Rack and the Console. Since the cable exits from the left leg of the Console, without the CEXT option, the Rack must be within two meters of the left side of the Console and within a half meter of its right side.

The CEXT option includes a ten meter cable. With this cable, the Computer Rack may be up to seven meters away from the left side of the Console and up to five and a half meters from its right side.

Parts

Table 10-4 lists the components that are included in the CEXT option, including the six sub-cables that are included in the ten meter long CEXT option W870 cable (see *Figure 10-4*).

Table 10-4: CEXT Option Components

NUMBER AND/OR DESCRIPTION		CONNECTION IN RACK [*]	P/N	QUANTITY
CEXT W870 10 meter cable includes the following sub-cables:			775-7180-70	1
1	Monitor power (W870/1)	PDU STR 2	IC0-0260-1100	1
2	Keyboard extender (W870/2)	O2 keyboard	IC0-0070-100M	1
3	Mouse extender (W870/3)	O2 mouse	IC0-0070-100M	1
4	Signal monitor (W870/4)	O2 signal plug	IC0-0060-010M	1
5	Footswitch out extender (W870/5)	AMC footswitch out J4B	775-7180-72	1
6	CT box cable (W870/6)	SDB panel J3	775-7180-71	1
Zipper tool to close the cable sleeve			-	1
CEXT option installation instructions			491-7162-0104	1

[*]. *Figure 10-3* shows how each sub-cable is connected in the Console.

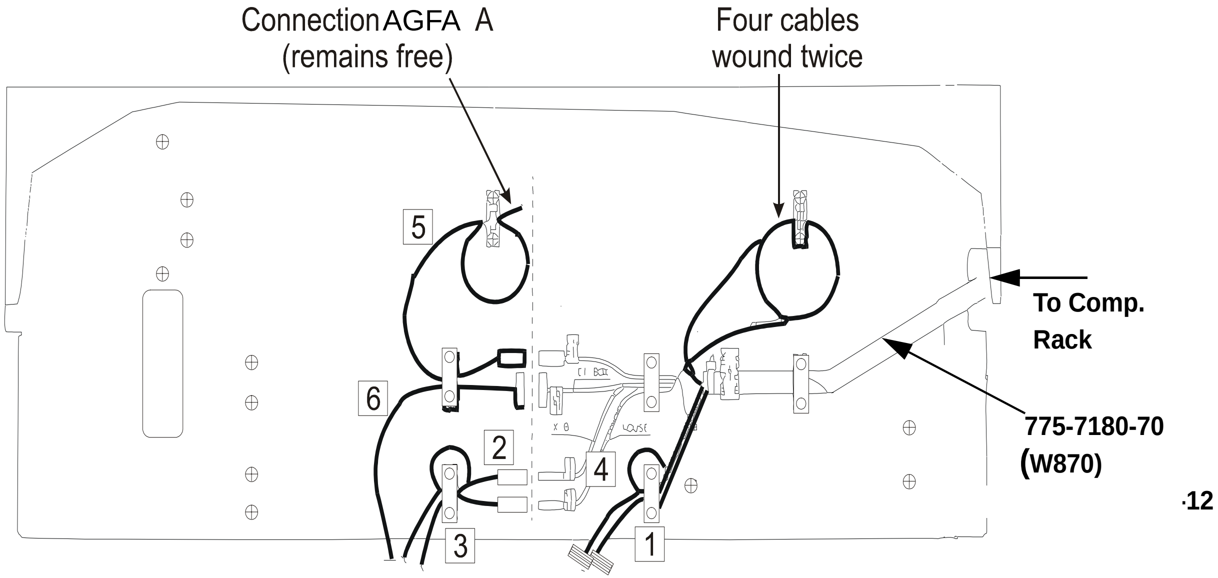

Connection AGFA A
(remains free)
Four cables
wound twice
5
6
2
3
4
1
CI BOX
X θ
MOUSE
To Comp.
Rack
775-7180-70
(W870)
·12

Figure 10-3: Sub-cable Connections and Layout in the Console

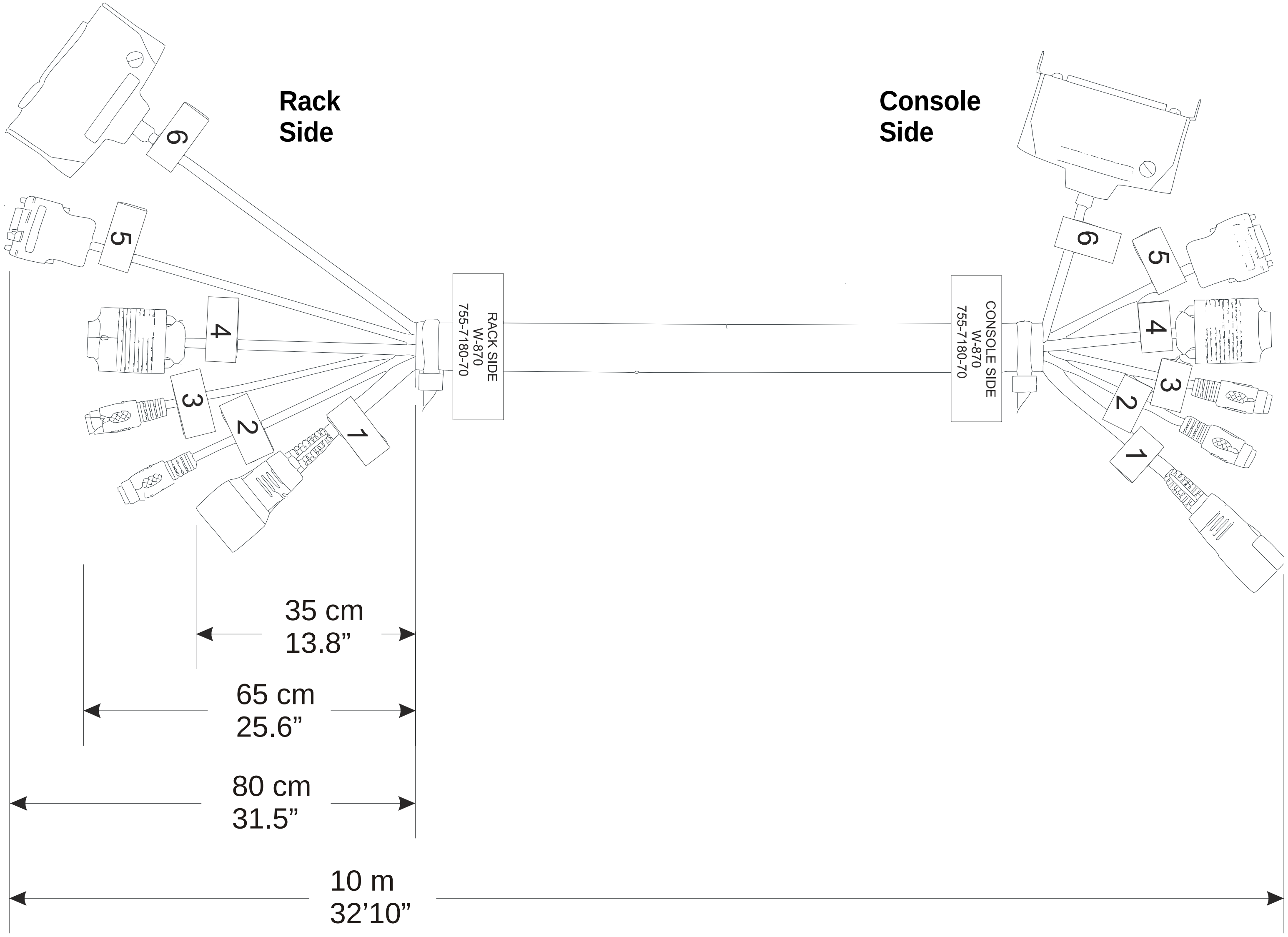

Rack Side
Console Side
6
5
4
3
2
1
RACK SIDE
W-870
755-7180-70
CONSOLE SIDE
W-870
755-7180-70
6
5
4
3
2
1
35 cm
13.8”
65 cm
25.6”
80 cm
31.5”
10 m
32’10”

Figure 10-4: Rack-Console Harness

Tools

You need the following to install this option:

- Standard FSE tool kit
- Zipper tool (included)
- About 20 tiewraps

Estimated Time

Estimated time to install this kit is three hours for one person.

Installation Procedure

Installing the CEXT option includes the following procedures:

1. Removing the W865 cable from the Rack
2. Removing the W865 cable from the Console
3. Installing the new W870 cable

Removing the W865 Cable from the Rack

Remove the W865 cable as follows:

1. Turn OFF the main power from the PDC.
2. Remove the two screws at the bottom of the back cover of the Rack, and remove the back cover.
3. Disconnect the W881 power-in cable of the Rack from the PDU at the bottom of the Rack (shown in *Figure 10-5*).
4. Disconnect the sub-cables listed in *Table 10-5* from the Rack. *Figure 10-5* shows how they are connected.

Table 10-5: W865 Sub-cables

#	DESCRIPTION	SYSTEM CABLE NUMBER	CONNECTION IN RACK
1	Monitor power cable	W865/1	PDU STR 2
2	Keyboard extender	W865/2	O2 computer keyboard
3	Mouse extender	W865/3	O2 computer mouse
4	Signal monitor cable	W865/4	O2 computer signal plug
5	Footswitch out extender	W865/5	AMC footswitch out
6	CT box cable	W865/6	SDB panel J3

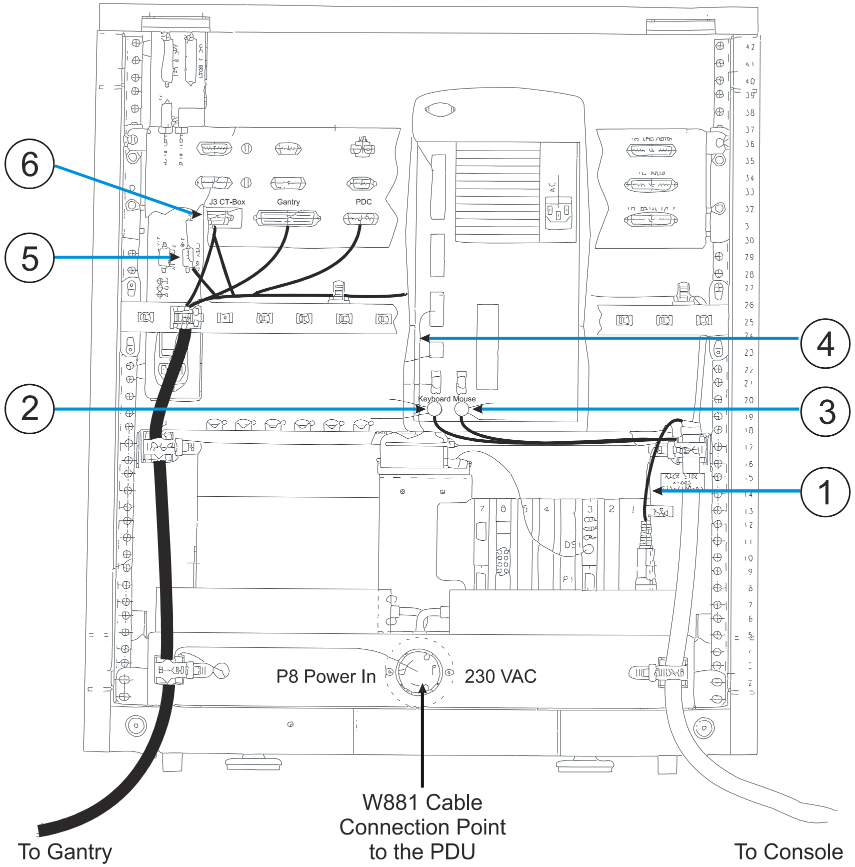

6
5
4
2
3
1
J3 CT-Box
Gantry
PDC
Keyboard Mouse
P8 Power In
230 VAC
W881 Cable
Connection Point
to the PDU
To Gantry
To Console

Figure 10-5: Rack System Connection - Rear View without Covers

5. Open the cable clamps from the W865 cable.

NOTE:

Do not tear the cable clamps. They can be opened and closed manually.

6. Remove the W865 cable.

Removing the W865 Cable from the Console

Remove the W865 cable from the console as follows:

1. Open the two screws (*Figure 10-6*) on the back cover of the Console and pull the cover out.

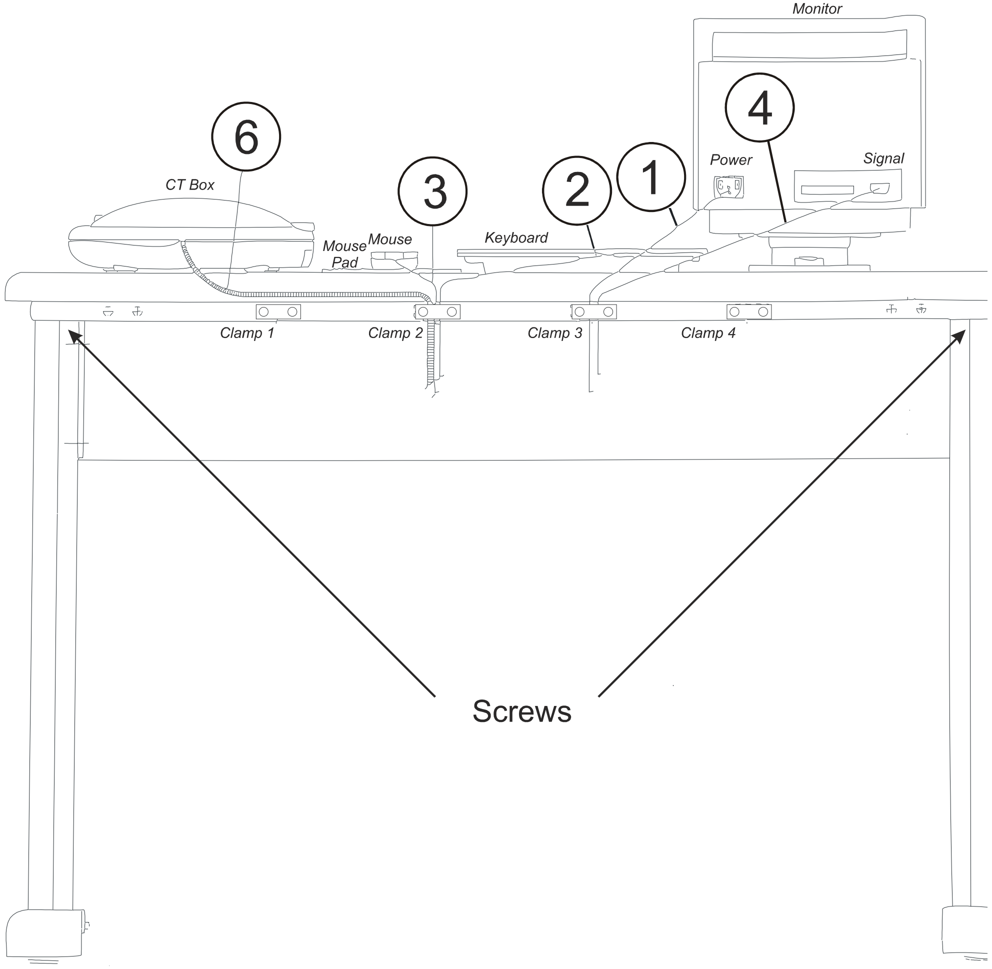

Monitor
6
3
2
1
4
Power
Signal
CT Box
Mouse Pad
Mouse
Keyboard
Clamp 1
Clamp 2
Clamp 3
Clamp 4
Screws

Figure 10-6: Console

2. Loosen, but do not remove, the four screws in the leg cover.
3. Remove the four screws that hold the metal cable cover (see *Figure 10-7*) in place. Lift up the metal cable cover and pull it out.
4. Disconnect the plugs from the back of the Console (see *Figure 10-6*).
5. Cut the tiewraps that hold the W865 cable in place.
6. Remove the W865 cable.

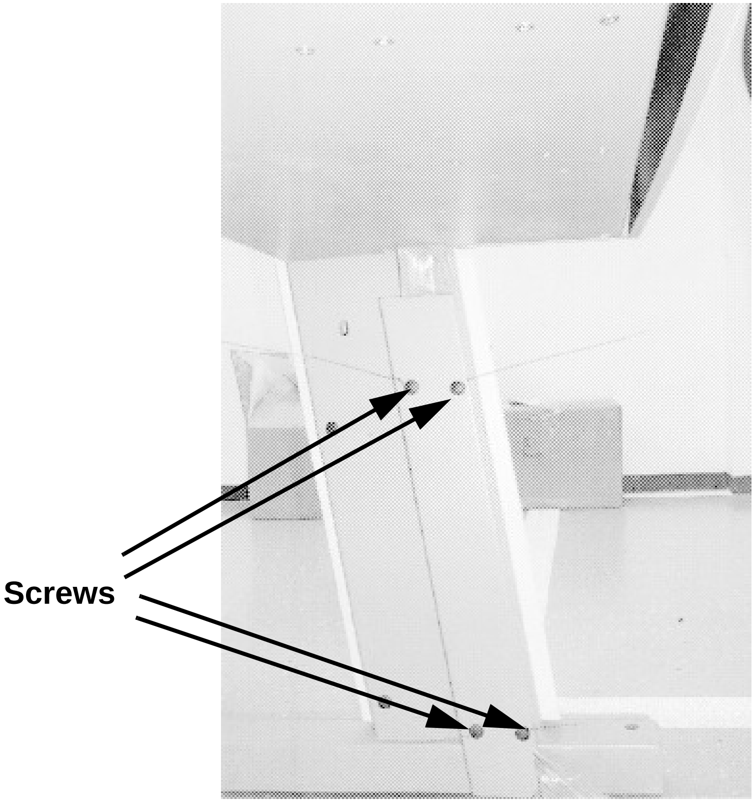


Figure 10-7: Metal Cable Cover Screws

Installing the W870 Cable

Install the new W870 cable as follows:

1. Insert the plug for each sub-cable (see *Table 10-4* and *Figure 10-4*) into the appropriate plug on the Console (see *Figure 10-6*).
2. Insert the plug for each sub-cable (see *Table 10-4* and *Figure 10-4*) into the appropriate plug on the Rack (see *Figure 10-5*).
3. Lay the W870 cable in its correct position.
4. Tie the W870 cable inside the Console using tiewraps.
5. Tie the W870 cable inside the Rack using cable clamps.
6. Connect the W881 Rack power-in cable.
7. Connect the main power in the PDC.
8. Check that the Console is operating properly.
9. Turn OFF the main power from the PDC.
10. Replace the Console and Rack covers.

Cardiac Prospective Gating

Cardiac Prospective Gating is a protocol used when acquiring data for the Mx8000 Cardiac Scoring application. It allows the use of an external ECG Gating System to synchronize individual axial scans with the patient’s heart beat. The ECG-triggered scans significantly minimize heart-motion artifacts.

Prerequisite

The Mx8000 Cardiac Prospective Gating Option requires MCU revision 06 or higher (see *Figure 10-8*). If your MCU revision is lower than 06, order a new MCU board and install it prior to Cardiac option installation.

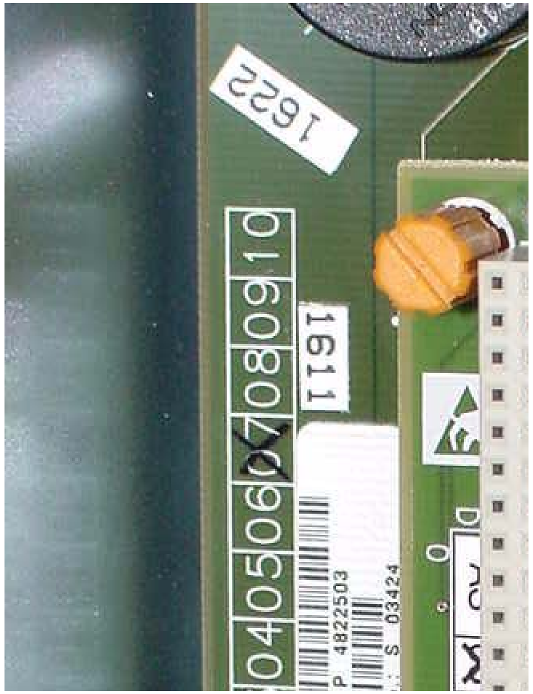


Figure 10-8:

Parts

DESCRIPTION	P/N
ECG Monitor	MD800071003
Signal Cable	775-7181-2906
Adapter Assembly	473-7181-2901
Operational Manual	490-7181-2900

Tools

Standard Field Service Tool Kit

Estimated Time

Estimated time is about a half hour

Setting Up the ECG Unit

Use the AccuSync® 71, 3 lead ECG Gating System (model 7100-3).

Refer to the AccuSync® 71 Operator’s Guide for complete results.

ECG Monitor Battery

THE ECG HAS A RECHARGEABLE BATTERY – CHARGE BEFORE THE FIRST USE AND BEFORE EVERY USE

The ECG unit is equipped with an internal rechargeable battery. This allows using it without being connected to an AC power outlet. When not in use, the monitor should be kept plugged into an AC outlet for charging. Twelve hours of charging yields about 90 minutes of operation. The AC mode of operation is the recommended mode; battery operation should be used only as a backup. For more details see the AccuSync® documentation.

Voltage Supply

The ECG monitor can be used with 110 V AC or 220 V AC— 50 Hz or 60 Hz. Refer to the AccuSync® operation manual for details.

⚠ WARNING

BEFORE PLUGGING THE UNIT INTO AN AC POWER OUTLET, ASCERTAIN THAT THE VOLTAGE SWITCH IS CORRECTLY SET IF NOT, THE UNIT WILL BE IRREPARABLY DAMAGED.

Making Connections to the ECG Unit

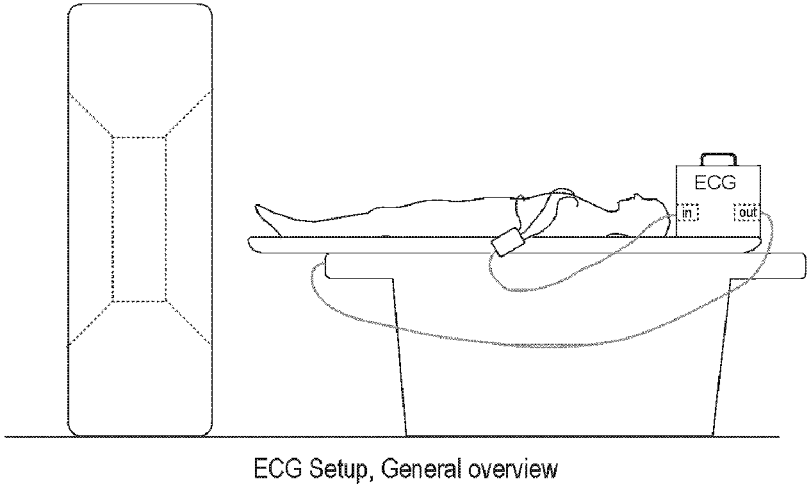


Figure 10-9: ECG Setup General Overview

1. Connect the Adapter Assembly (473-7180-2901) to the D-type connector at the gantry-end of the bed (the connector on the bed is labeled **X707**—see *Figure 10-10* and *Figure 10-11*).

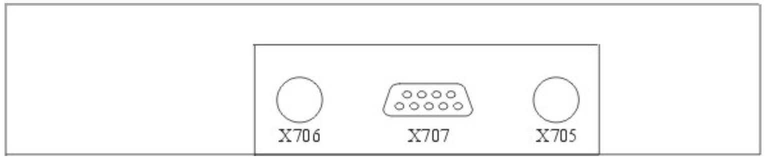


Figure 10-10: Bed Panel Connections

NOTE:

The Adapter Assembly should stay connected at all times.

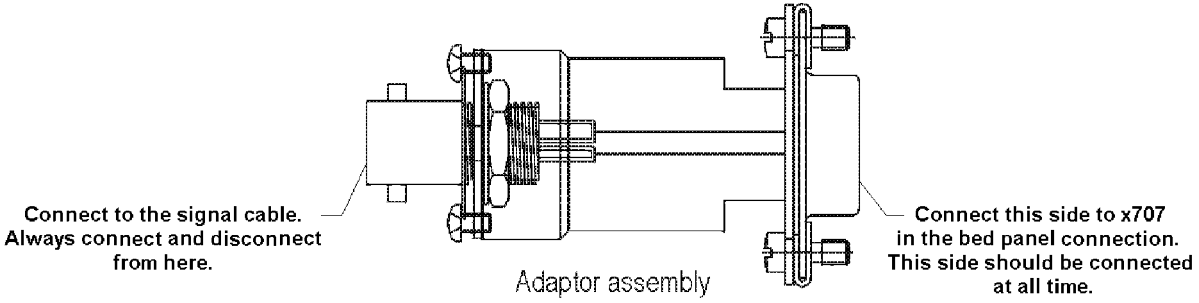

Connect to the signal cable.
Always connect and disconnect
from here.
Adaptor assembly
Connect this side to x707
in the bed panel connection.
This side should be connected
at all time.

Figure 10-11: Adaptor Assembly

2. Connect the output signal cable between the R TRIG connector on the back panel of the ECG unit (see *Figure 10-12*) and the Adapter Assembly at the gantry-end of the bed (the connector on the bed is labeled **X707**).
3. Connect the 3-lead patient electrode cable to the ECG IN connector on the front panel of the ECG unit (see *Figure 10-13*).

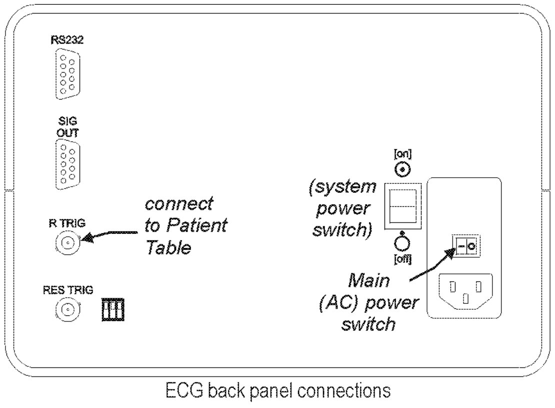

RS232
SIG OUT
R TRIG
RES TRIG
connect to Patient Table
(system power switch)
[on]
[off]
Main (AC) power switch
ECG back panel connections

Figure 10-12: ECG Back Panel Connectors

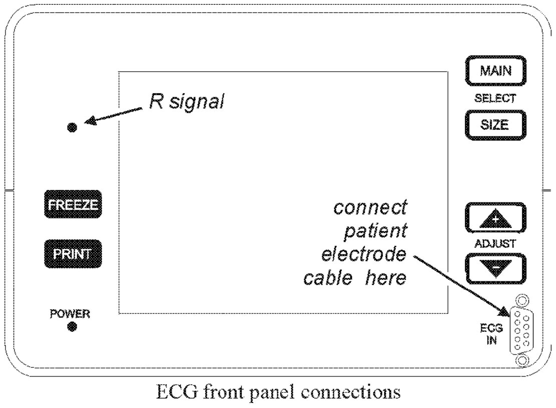

R signal
MAIN
SELECT
SIZE
FREEZE
PRINT
POWER
ADJUST
connect patient electrode cable here
ECG IN
ECG front panel connections

Figure 10-13: ECG Front Panel Connections

Final Steps

Test the system according to the Cardiac Prospective Gating operation manual.

CCT Site Preparation

This manual contains the necessary structural requirements and layout for the installation of the Mx8000 CCT overhead monitor option.

The information in this manual is intended for people with adequate backgrounds and experience in the installation, use, and servicing of mechanical and electromechanical devices. Philips cannot be responsible for the interpretation of this information, nor can Philips assume any liability in connection with its use.

NOTE:

The procurement and installation of the monitor support column mounting plate and the installation of its support structure is the sole responsibility of the architect or engineer of record at the specific site. Philips Medical Systems accepts no liability for the installation of the monitor support structure.

Maximum cable length for the 220VAC power cord and for the video cable is 24m.

Safety Notes

WARNING

INSTALLATION OF THE OVERHEAD COUNTERPOISE SYSTEM (OCS) MUST BE PERFORMED BY QUALIFIED PERSONNEL. ANY ATTEMPT TO INSTALL OR REPAIR AN OCS UNIT BY UNAUTHORIZED OR UNQUALIFIED PERSONNEL CAN RESULT IN AN UNSAFE MOUNT THAT, OVER TIME, CAN LOOSEN AND FALL AND CAUSE BODILY INJURY AND PROPERTY DAMAGE.

- **Do not use the OCS in a magnetic environment.** The OCS units are constructed of ferrous material. Do not install in a Magnetic Resonance suite. In the presence of a strong magnetic field, the OCS could be forcefully drawn to the source of magnetism in an unpredictable and dangerous manner. Bodily harm and/or property damage may result.
- Failure of the OCS to remain in a desired position, or lateral drifting of the OCS to the same position could precede a system failure that can result in bodily harm and/or damage. If the OCS does not reliably remain where positioned, inspect the yoke assembly and support pins for wear or damage.
- Do not hang or place additional equipment on the horizontal support arm. The horizontal support arm of the OCS is designed and adjusted to support a monitor only. Placing other equipment on the horizontal support arm adds weight that the arm was not designed to support. Hanging unauthorized or additional equipment can result in an unsafe system. If any other device, such as a surgical lamp or lead shield is to be installed, consult the manufacturer of this equipment for the necessary electrical and mechanical requirements.

CAUTION

Ceiling Anchorage Stresses

Because of the stresses involved, the existing ceiling must be capable of bearing such stresses as described in *"Seismic Anchorage With Ceiling Plate"*. This report suggests that ceiling-mounted systems must be capable of supporting 818 kg per fastener.

- Suspended Ceilings
  The installation procedures presume the mounting of the OCS into concrete. In any other type of construction, adapt the mount to suit, and ensure adequate support. With suspended or false ceilings, the OCS should be mounted to the main structure of the building, and not to the framework of the suspended ceiling. The installer must provide metal framework, a bracket, or some other arrangement to properly support the mounting system.

Site Preparation Prerequisites

The following are the structural requirements for the installation of the overhead monitor option:

Ceiling Height:

Maximum Height: 3.00 m	For ceilings whose height exceeds 3.00 m, the customer must prepare a metal frame to lower the anchoring height to a maximum of 3.00 m.
Minimum Height: 2.65 m	The overhead monitor option cannot be installed at sites with ceilings less than 2.65 m. The customer must purchase the cart option.

Support Column Positioning

For Existing Mx8000 Systems

The support column base must be anchored according to the following instructions:

1. Move the bed to Max out.
2. Position the monitor support column mounting plate on the ceiling 40 cm past the gray line along the center length axis of the bed, away from the Gantry (see *Figure 10-14*).

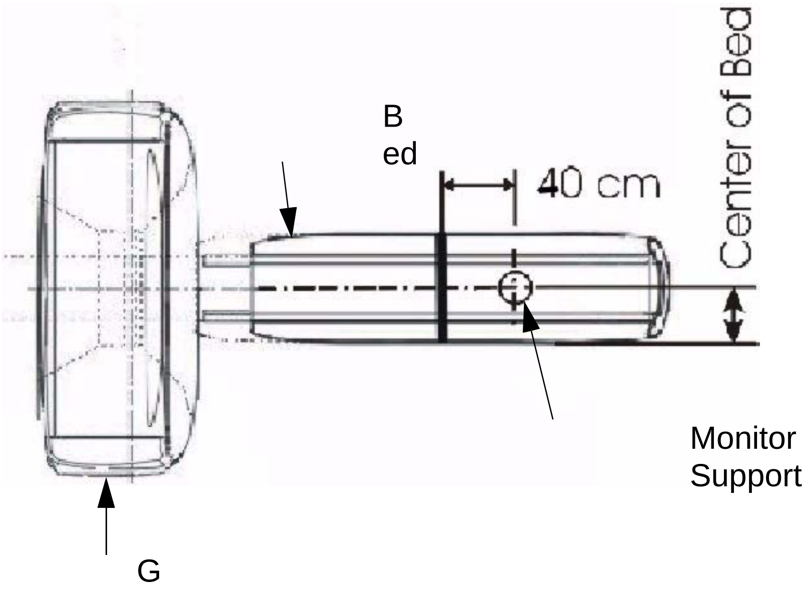


Figure 10-14: Location of the Monitor Support Column Mounting Plate on Ceiling

For Mx8000 Systems Not Yet Installed

Figure 10-15 illustrates the location of the overhead monitor support mounting plate **on the ceiling** with reference to the mylar template used for installation of the Mx8000.

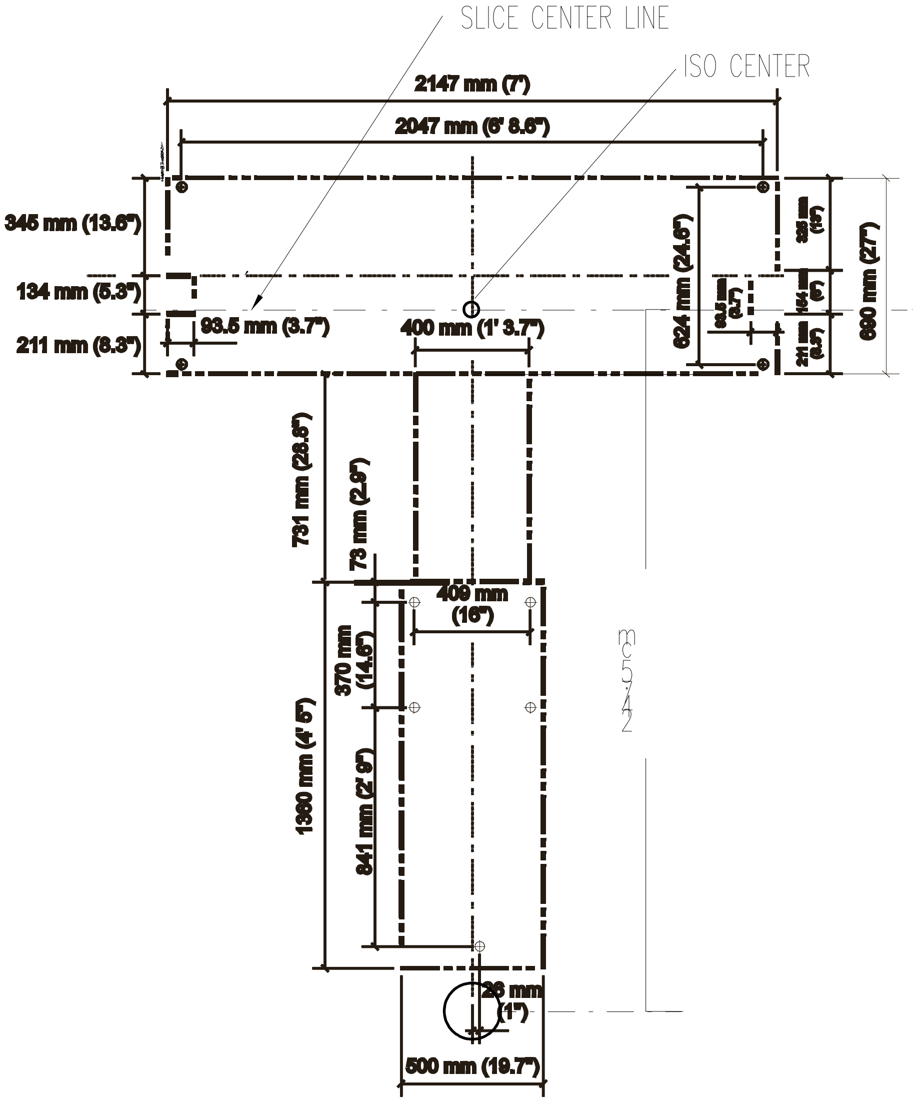

SLICE CENTER LINE
ISO CENTER
2147 mm (7')
2047 mm (6' 8.6")
345 mm (13.6")
134 mm (5.3")
211 mm (8.3")
93.5 mm (3.7")
400 mm (1' 3.7")
624 mm (24.6")
93.5 mm (3.7")
325 mm (13")
164 mm (6")
211 mm (8.3")
690 mm (27")
731 mm (28.8")
73 mm (2.9")
409 mm (16")
370 mm (14.6")
1360 mm (4' 5")
841 mm (2' 9")
247.5cm
26 mm (1")
500 mm (19.7")

Figure 10-15: Location of Monitor Support Column Mounting Plate on the Ceiling—New System

Structural Details

The *Figure 10-16* details the method of anchoring the monitor support column to the ceiling or metal framework.

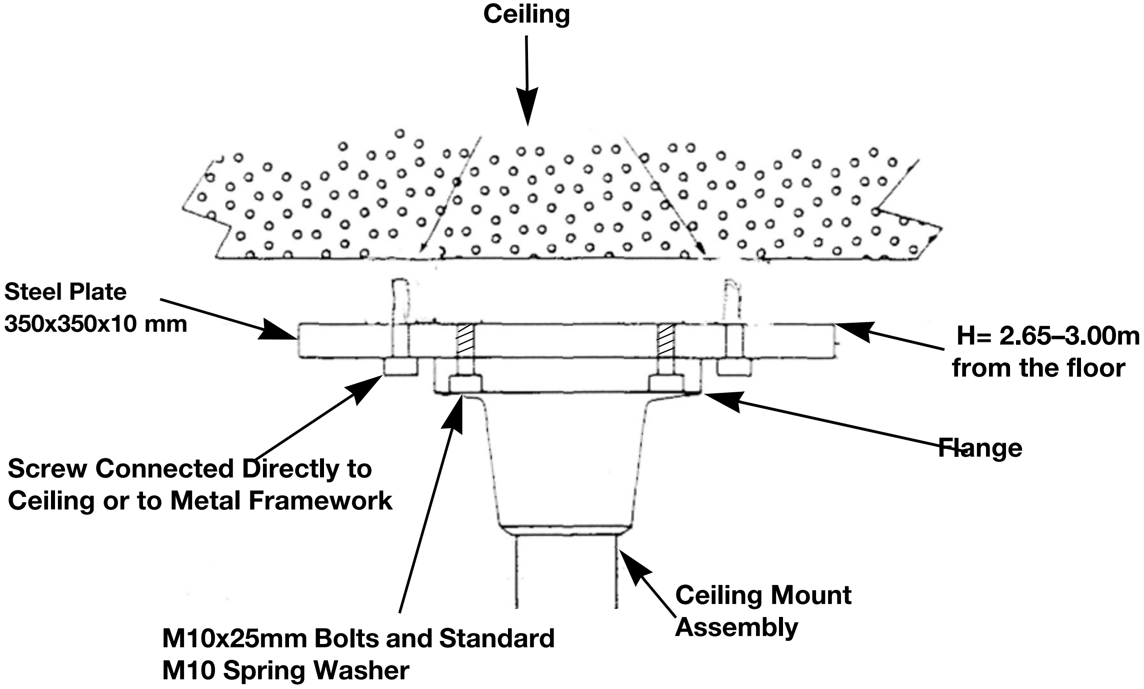

Ceiling
Steel Plate
350x350x10 mm
H= 2.65–3.00m
from the floor
Flange
Screw Connected Directly to
Ceiling or to Metal Framework
Ceiling Mount
Assembly
M10x25mm Bolts and Standard
M10 Spring Washer

Figure 10-16: OCS With Mounting Plate

NOTE:

M10 Bolts and M10 standard spring washers must be provided by the customer.
M10 Length—25 mm
Tighten bolts to a torque of 80 Nm

Seismic Anchorage With Ceiling Plate

Ta= 818 kg/Bolt (Max)

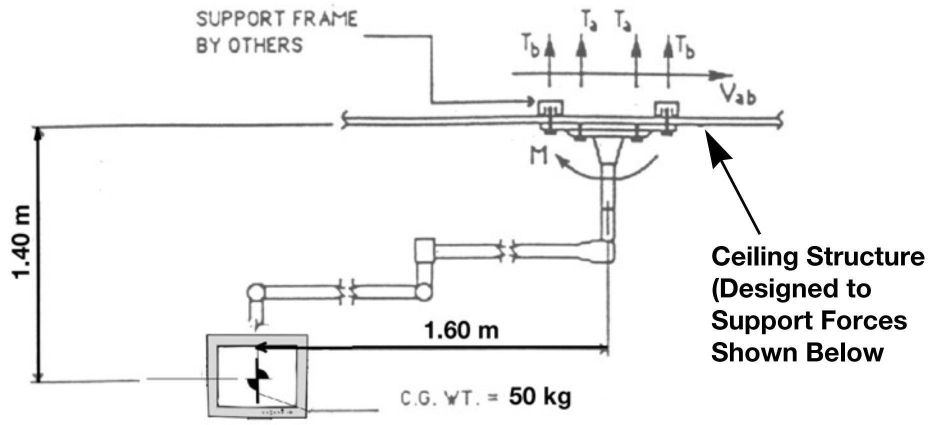
Va= 122 kg/Bolt (Max)

M = 124.3 kg/m (Max)

Tb= 359 kg/Bolt (Max)

Vb= 55 kg/Bolt (Max)

M = 124.3 kg/m (Max)



Ceiling Structure (Designed to Support Forces Shown Below

Figure 10-17: Elevation Diagram with Forces

NOTE:

Forces are determined per California Code of Regulations, Title 24, Table 23P.
Horizontal Acceleration (V_h) = 0.45W
Vertical Acceleration (V_v) = 0.16W

a. Forces are maximums, and occur when equipment is moved to the most eccentric position.

b. Provide ceiling structure designed to support weights and forces shown (by engineer of record for the building).

Load Calculation: Ceiling—Mounting Plate

Loads:

Weight W = 50 kg

Horiz. Accel V_h = 22.5 kg

Vert. Accel V_v = 8 kg

Bolt Group Props (Bolts "B")	**Moments**
Ix-x = 0.065	Mxx=Mzz=Mw-w = (50+8)1.600 + 22.5(1.400) = 124.3 kg/m
Iz-z = 0.065	Myy=22.5(1.6) = 36 kg/m
Iy-y = 0.13	
Iw-w = 0.065	

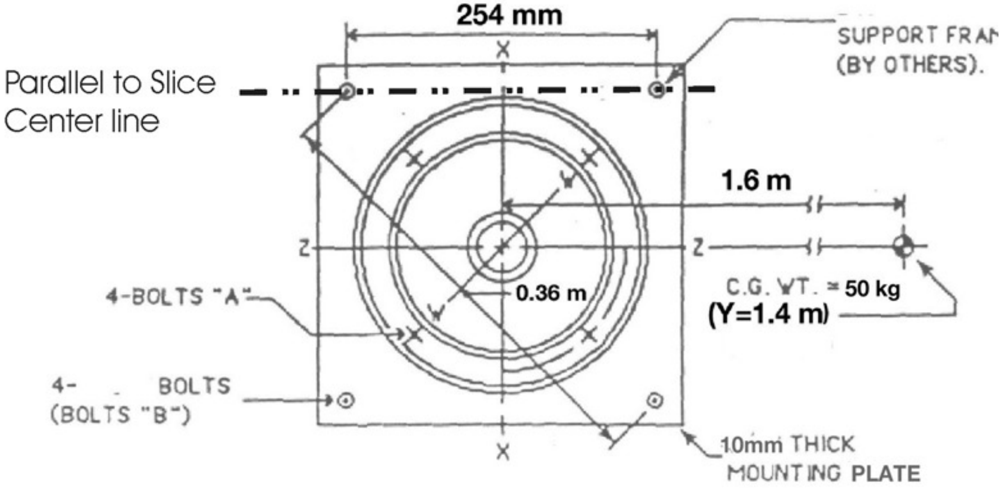

254 mm
SUPPORT FRA
(BY OTHERS).
Parallel to Slice
Center line
X
1.6 m
Z
Z
0.36 m
W
W
C.G. WT. = 50 kg
(Y=1.4 m)
4-BOLTS "A"
4- BOLTS
(BOLTS "B")
X
10mm THICK
MOUNTING PLATE

Figure 10-18: Steel Plate: Dimensions for Mounting to Ceiling

Bolt Forces

Tension (T)

$$T = \frac{50+8}{4} + \frac{124.3 \times 0.180}{0.065} = 359 \text{ kg/Bolt}$$

Shear (V)

$$V = \frac{22.5}{4} + \frac{36 \times 0.18}{0.13} = 55 \text{ kg/Bolt}$$

Load Calculation: Mounting Plate—Monitor Support Arm

Loads:

Weight W = 50 kg

Horiz. Accel V_h = 22.5 kg

Vert. Accel V_v = 8 kg

Bolt Group Props (Bolts "A")	Moments
Ix-x = 0.0116	Mxx=Mzz=Mw-w = (50+8)1.6+22.5(1.4) = 124.3kg
Iz-z = 0.0116	Myy=22.5(1.6) = 36 kg/m
Iy-y = 0.0232	
Iw-w = 0.0116	

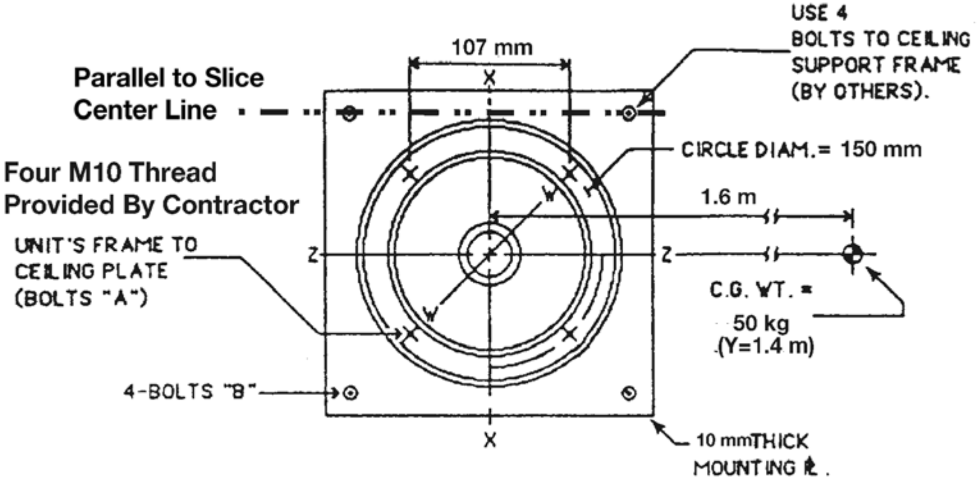

USE 4
BOLTS TO CEILING
SUPPORT FRAME
(BY OTHERS).
107 mm
X
Parallel to Slice
Center Line
CIRCLE DIAM.= 150 mm
Four M10 Thread
Provided By Contractor
1.6 m
W
UNIT'S FRAME TO
CEILING PLATE
(BOLTS "A")
Z
Z
W
C.G. WT. =
50 kg
(Y=1.4 m)
4-BOLTS "B"
X
10 mmTHICK
MOUNTING ℓ .

Figure 10-19: Steel Plate: Dimensions for Mounting to Monitor Support Column

Bolt Forces

Tension (T)

$$T = \frac{50 + 8}{4} + \frac{124.3 \times 0.075}{0.0116} = 818 \text{ kg/Bolt}$$

Shear (V)

$$V = \frac{22.5}{4} + \frac{36 \times 0.075}{0.0232} = 122 \text{ kg/Bolt}$$

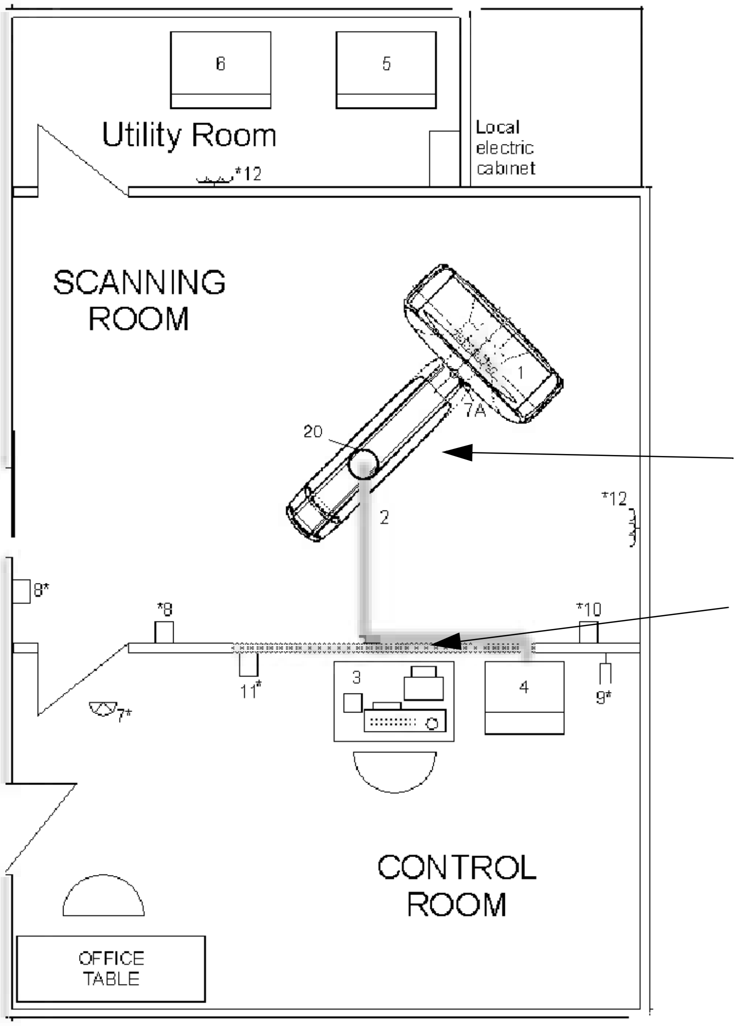
Cable Ducts and Routing

NOTE:

This is a typical layout. Verify location of unit no. 4 in the specific site layout.

Site preparation includes the installation by the customer of suitable ducts and troughs located on the ceiling for cable routing from the console to the location of the overhead monitor support.

Ducts and troughs should be a minimum of 2"x2".


6
5
Utility Room
*12
Local
electric
cabinet
SCANNING
ROOM
1
7A
20
2
*12
8*
*8
*10
3
4
11*
9*
7*
CONTROL
ROOM
OFFICE
TABLE

**CCT
Option**

**Cable Duct
From Unit
No.4 to**

**NOTE:
MAXIMUM
DUCT
LENGTH: 24**

Figure 10-20: Typical Layout of a Mx8000 System with CCT Option

CCT Installation

Continuous CT (CCT) is a Mx8000 option that enables physicians and radiologists to produce real-time CT images to facilitate image-guided surgery. The physician initiates the scan within the Gantry room by pressing a footswitch located near the patient table.

The physician is guided by a ceiling-mounted 20" LCD monitor or cart-mounted CRT monitor that is connected by means of a video amplifier to the monitor of the Mx8000 operating station. The monitor in the Gantry room displays the same image which is shown on the monitor at the console.

Tools Required

- Standard FSE tool kit
- A ladder (for ceiling-mounted units)

Estimated Time

The estimated time for installation is:

- CCT option only—four hours
- Ceiling-mounted monitor—four hours (two people are required)

Preface

This manual instructs service personnel in the installation of the Continuous CT option for the Mx8000.

The installation involves the following activities:

1. Installation of the video amplifier at the console
2. Footswitch connection
3. Monitor assembly and connection

Prerequisite

Verify that the MCU revision is **AS06**. If your revision is lower than AS06, replace the MCU board.

> **NOTE:**
>
> Any MCU board replacement must be with revision AS06 or higher.

Parts

There are two variations for the CCT option:

- With ceiling-mounted flat LCD monitor Kit P/N 48071804008
- With cart-mounted CRT monitor Kit P/N 48071801608

Table 10-1: CCT Option with Ceiling-Mounted Monitor Kit
P/N 48071804008

ITEM	DESCRIPTION	P/N	QTY
1	Footswitch	BR712793771	1
2	Power Cable 1m	IC002601051	1
3	LCD Flat Monitor	CP00052010X	1
4	Power Cable & Video Cable 25m	77571811601	1
5	Monitor Support Arm	BR800178444	1
6	Monitor Support	BR800178710	1
7	Installation Instructions	49071810711	1
8	Server Base	565718044	1
9	Video amplifier	CP000504602	1
10	Video amplifier Clamp	565718075	1
11	Video amplifier P.S. Clamp	565718076	1
12	Nut NC 12	HN305001224	4
13	Screw NC12	HS01109608C	4
14	Cable Tie Mount	XW025000203	4
15	Self Locking Nut	HS12159406C	8
16	Cable Tie	XW025000012	24

Table 10-2: CCT Option with Cart-Mounted Monitor Kit
P/N 48071801608

ITEM	DESCRIPTION	P/N	QTY
1	Footswitch	BR712793771	1
2	CRT Monitor	CP000521402	1
3	Cart	47371805301	1
4	Installation Instructions	49071810711	1
5	Server Base	565718044	1
6	Video amplifier	CP000504602	1
7	Video amplifier Clamp	565718075	1
8	Video amplifier P.S. Clamp	565718076	1
9	Nut NC 12	HN3050012224	4
10	Screw NC12	HS01109608C	4
11	Cable Tie Mount	XW025000203	4
12	Self Locking Nut	HS12159406C	8
13	Cable Tie	XW025000012	20
14	Power Cable 1 Meter	IC002601051	1
15	Power Cable & Video Cable 25m	77571811502	1
16	Velcro Strap	56271815104	1

Assembly Procedure

The procedure describes the assembly and connection of the video amplifier to the server base, mounting of the server base to the rack in the console, and connection to the O2.

Server Base Assembly

1. Attach the cable tie mounts to the server base with the eight self-locking nuts. Insert the cable ties into the mounts. The cable ties secure the excess wire.

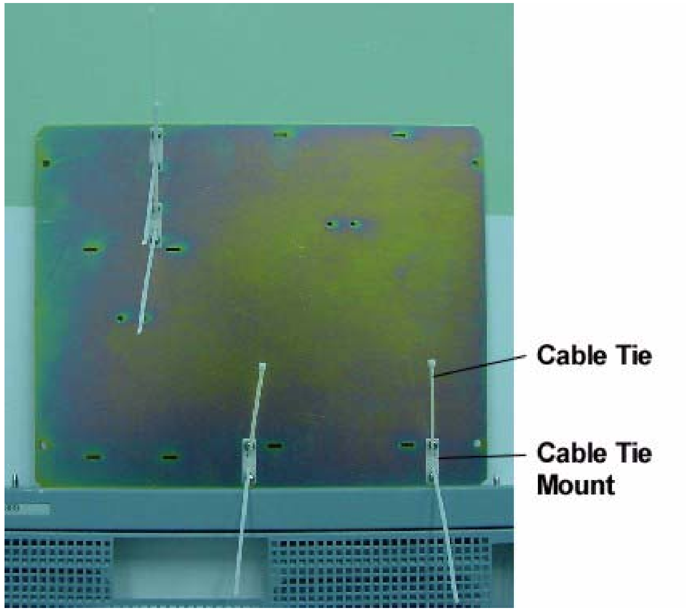


Figure 10-21: Server Base and Cable Ties

2. Assemble the video amplifier and its power supply to the server base with the clamps. Arrange the video amplifier so that 15-pin input jacks face the edge of the server base and that the power cable leading to the power supply faces the inside of the server base.

   Each clamp has teeth on one side that are inserted into the rectangular holes in the server base, and a screw that fastens to the server base on the other side (see *Figure 10-22*).
3. Wind the excess power supply cable and secure it with the cable tie as shown in *Figure 10-22*.

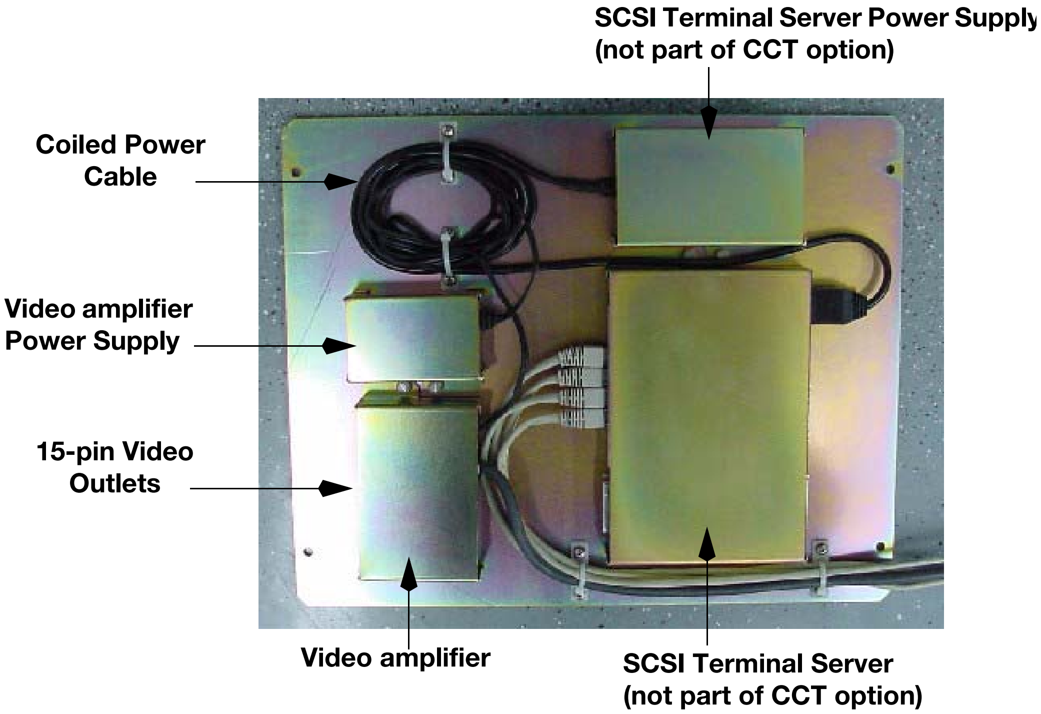

SCSI Terminal Server Power Supply
(not part of CCT option)
Coiled Power
Cable
Video amplifier
Power Supply
15-pin Video
Outlets
Video amplifier
SCSI Terminal Server
(not part of CCT option)

Figure 10-22: Assembled Server Base

Server Base Mounting

1. Open the front panel of the computer rack.
2. Attach four nuts (u-nut type) to the vertical uprights in the computer rack so that they are parallel to the holes in each corner of the server base. Use the third hole from the top and the fourth hole from the bottom on the vertical upright. The nut wraps around the vertical uprights (see *Figure 10-23*).
3. Attach the server base with the four screws. The video amplifier side of the server base faces the front of the computer rack (see *Figure 10-24*).

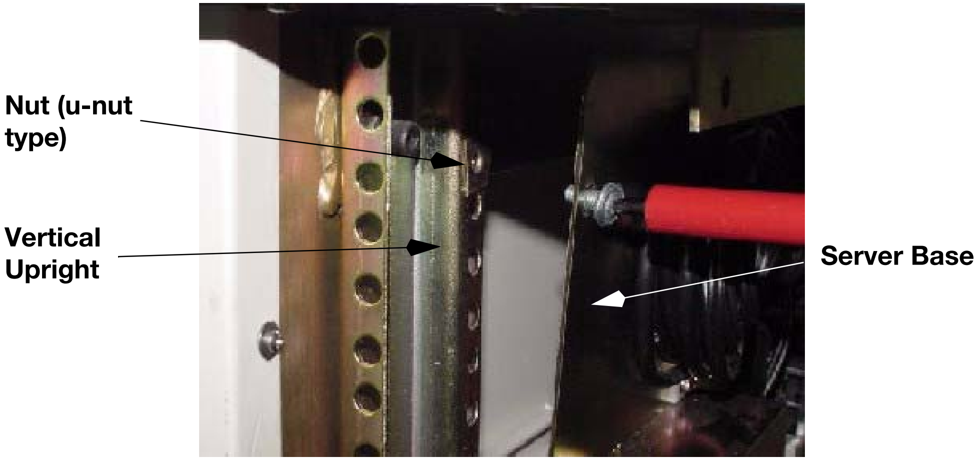


Figure 10-23: Server Base Mounting

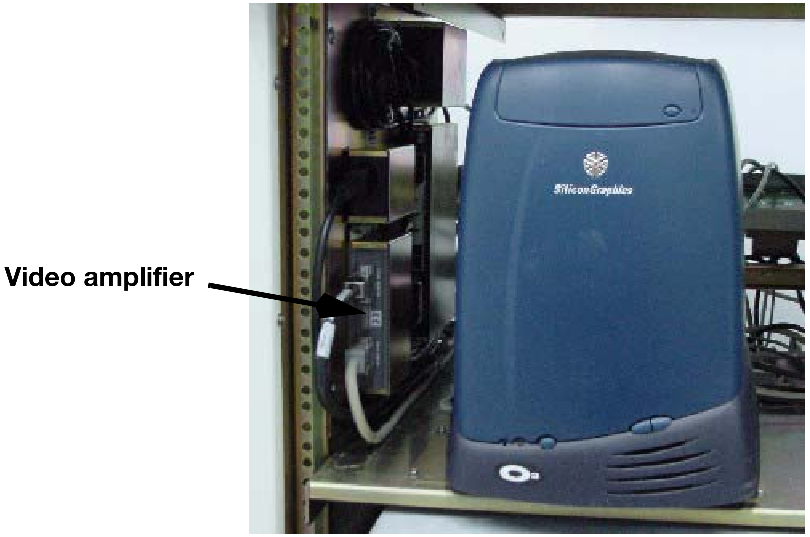


Figure 10-24: Front of Computer Rack

4. Detach the video cable from the rear of the O2 (see *Figure 10-25*).
5. Connect the video amplifier monitor cable to the monitor jack of the O2.
6. Connect the console monitor cable to the jack labeled "Local Monitor" in the video amplifier (see *Figure 10-26*).
7. Connect the video amplifier power supply cable to the power supply and to the multi-outlet bank in the rear of the rack.

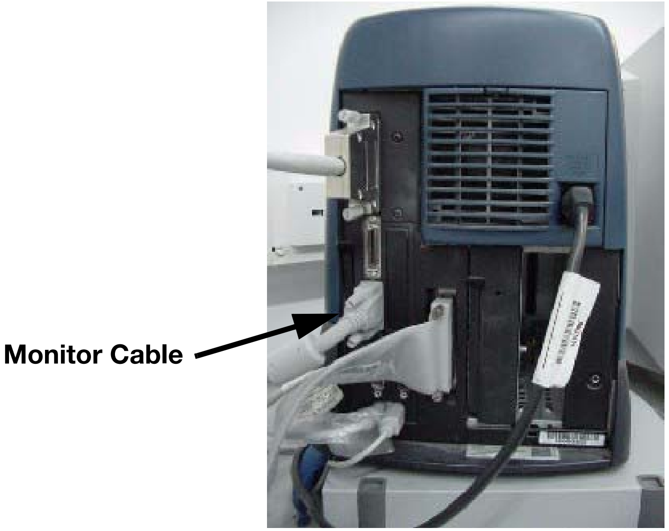

Monitor Cable

Figure 10-25: Rear of Computer

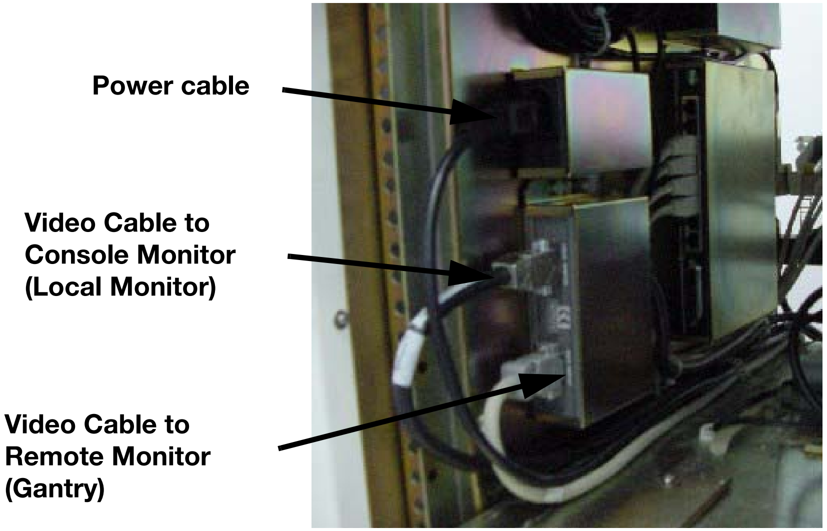

Power cable
Video Cable to
Console Monitor
(Local Monitor)
Video Cable to
Remote Monitor
(Gantry)

Figure 10-26: O2 Monitor Connection

Footswitch Installation

The setup of the CCT scan is done from the console. When scan parameters are confirmed, the footswitch enables the scan. During CCT mode, the physician is able to initiate and conclude a scan for up to two minutes by pressing the footswitch. As long as the footswitch is pressed, x-ray and acquisition remain active. The repetition of the scan is possible as often as desired by pressing the footswitch.

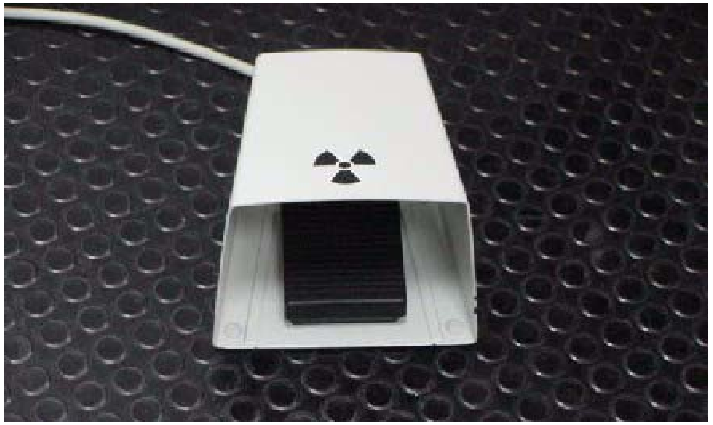


Figure 10-27: CCT Footswitch

Installation

Install the footswitch as follows:

1. Locate Connector J313 at the lower rear left side of the Gantry.
2. Insert the plug of the footswitch into the connector.

The footswitch can be used on either side of the Gantry.

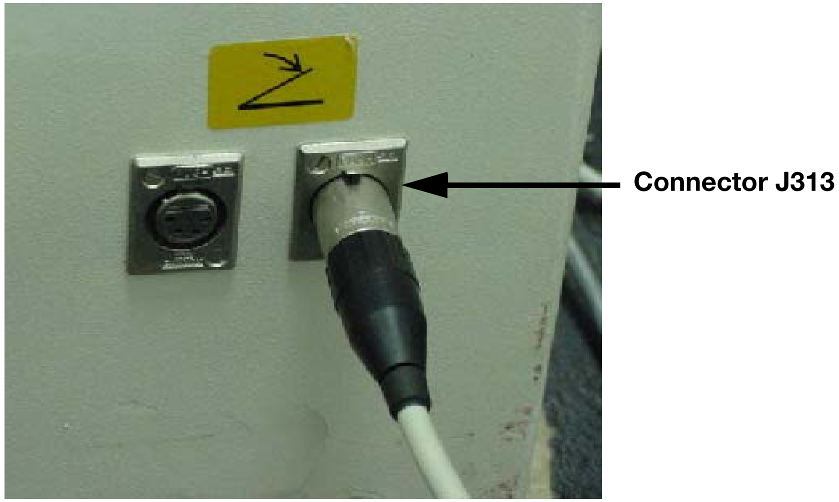


Figure 10-28: Connector J313 With Footswitch Plug

Overhead Monitor Option

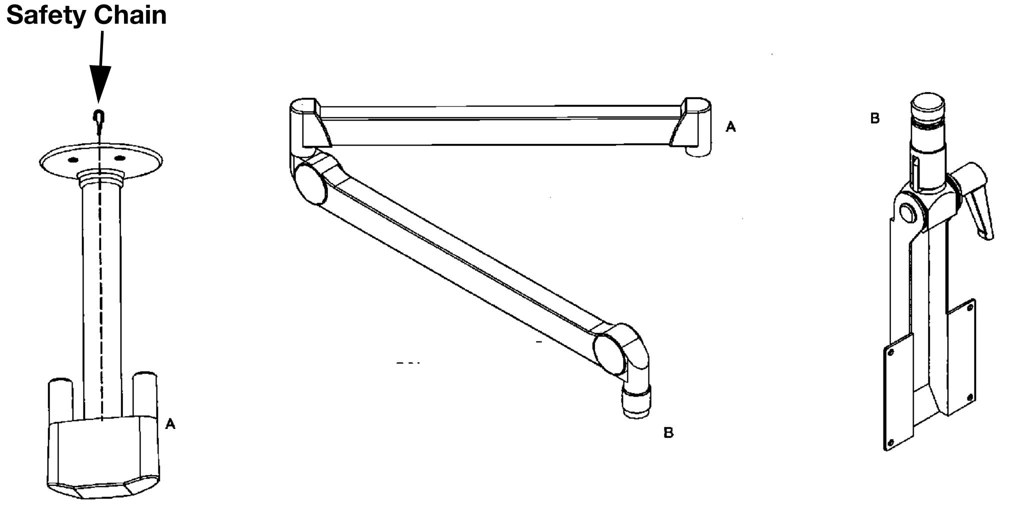
The overhead LCD monitor is one of the two alternatives available for installation inside the Gantry room. The overhead monitor assembly consists of the following:

Monitor Arm Assembly

- LCD Flat Monitor
- Monitor Support Cable Arm (arm assembly)
- Monitor Support Vertical (ceiling column mount)
- Monitor Support
- Power Cable and Video Cable 25m
- Cable Ties

NOTE:

Ends marked "A" are joined together.
Ends marked "B" are joined together.



Monitor Support Vertical (Ceiling Column Mount)

Monitor Support Arm

Monitor Support

Figure 10-29: CCT Monitor Arm Assembly

Refer to the manufacturer's instructions when assembling the monitor support and column. Make sure that Post A is facing the Gantry (see *Figure 10-30*) and that the column is parallel to the center axis of the bed.

WARNING

ASSEMBLY OF THE SAFETY CHAIN IS **MANDATORY!**

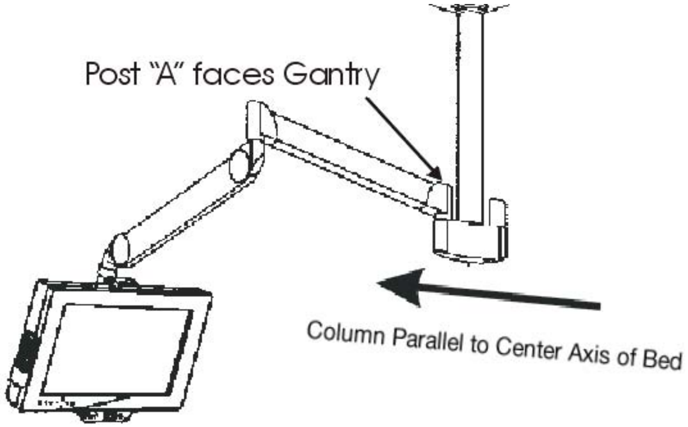


Figure 10-30: Direction of Monitor Support Column

The column is assembled so that the power and the video cable are routed through the access points shown in *Figure 10-31*. The manufacturer's instructions refer to load or tension adjustment. This adjustment is made so that the CCT monitor hangs in a "neutral- weight" balance. Any touch upward causes it to rise; firmer pressure downward should easily lower the monitor.

NOTE:

Monitor Support Column Mounting Plate and its support structure is the responsibility of the architect or engineer of record at the specific site. For instructions on mounting plate placement, see the CCT Site Preparation Guide (P/N 491-7181-2305).

1. Locate the Ceiling Column Mount. The ceiling should be prepared prior to installation.
2. After attaching the Ceiling Column mount to the ceiling, see *Figure 10-29* and locate the manufacturer's instructions for the monitor arm assembly.

3. Remove the base from the CCT monitor and discard it, it is not used for this application. See manufacturer's instructions for monitor base removal.

NOTE:

Save the four mounting screws; you need them to mount the monitor to the Monitor Arm Assembly.

Monitor Cable Connections

1. Locate the Power and Video Extension Cable and route it from the ceiling as shown in *Figure 10-31*.
2. See *Figure 10-31* for cable routing instructions. Use cable ties to secure the power and video cables to the monitor support column and arm.

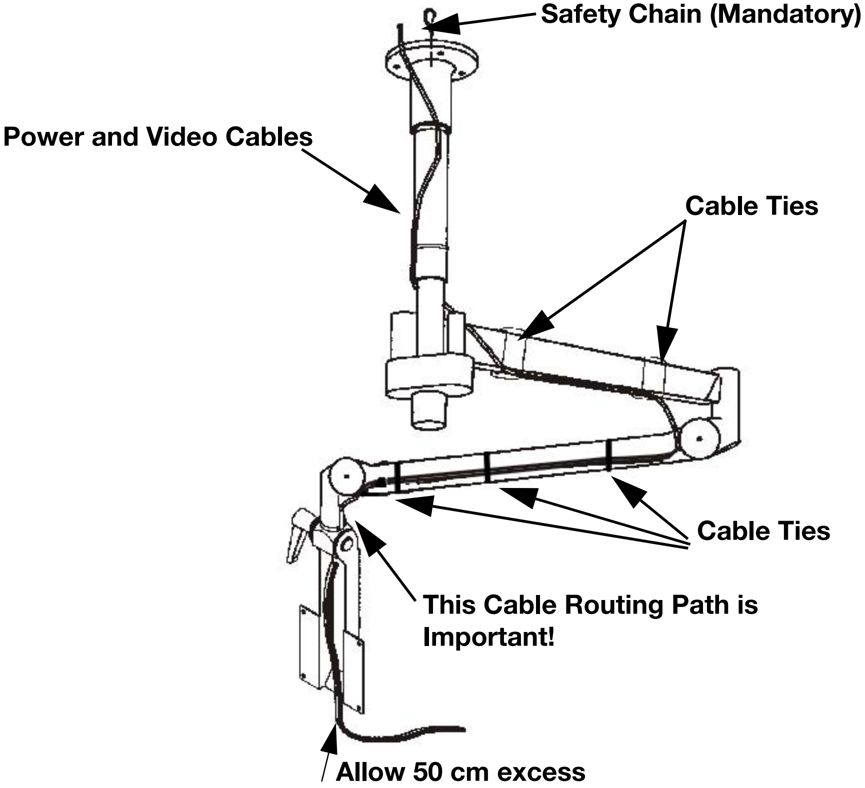

Safety Chain (Mandatory)
Power and Video Cables
Cable Ties
Cable Ties
This Cable Routing Path is Important!
Allow 50 cm excess

Figure 10-31: CCT Monitor Support Assembly and Cable Routing

3. Connect the remote monitor cable (the cable that connects to the CCT monitor in the Gantry room) to the jack labeled "Data Display" on the video amplifier in the computer rack.

NOTE:

Cables should be routed using the ducts and troughs specifically installed for this option.

4. Use the mounting screws saved from the monitor base removal and attach the CCT monitor to the Monitor Support Arm assembly.
5. Connect the power cable.
6. Connect the video cable to input 1.

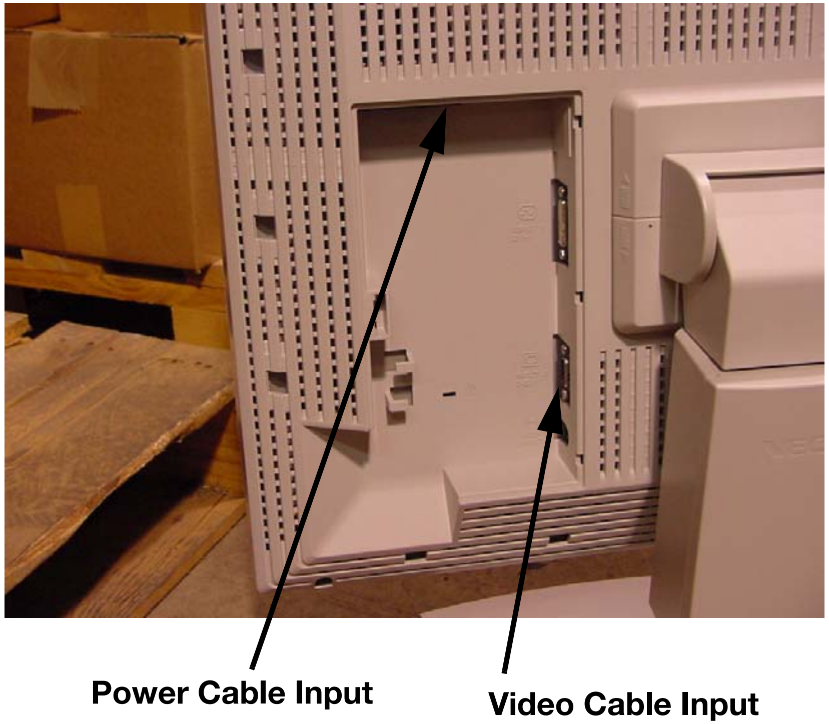


Figure 10-32: CCT Monitor with Cable Connections

Cart Monitor Option

The cart monitor is one of the two alternatives available for installation inside the Gantry room. The cart monitor assembly consists of the following:

- CRT Monitor
- Cart
- Power Cable and Video Cable 25m
- Velcro® Strap

Cart Assembly

1. Place the CRT monitor on the cart platform in between the front and rear slots.
2. Connect the power cable to the monitor.
3. Connect the video cable to input 1 in the rear of the monitor.

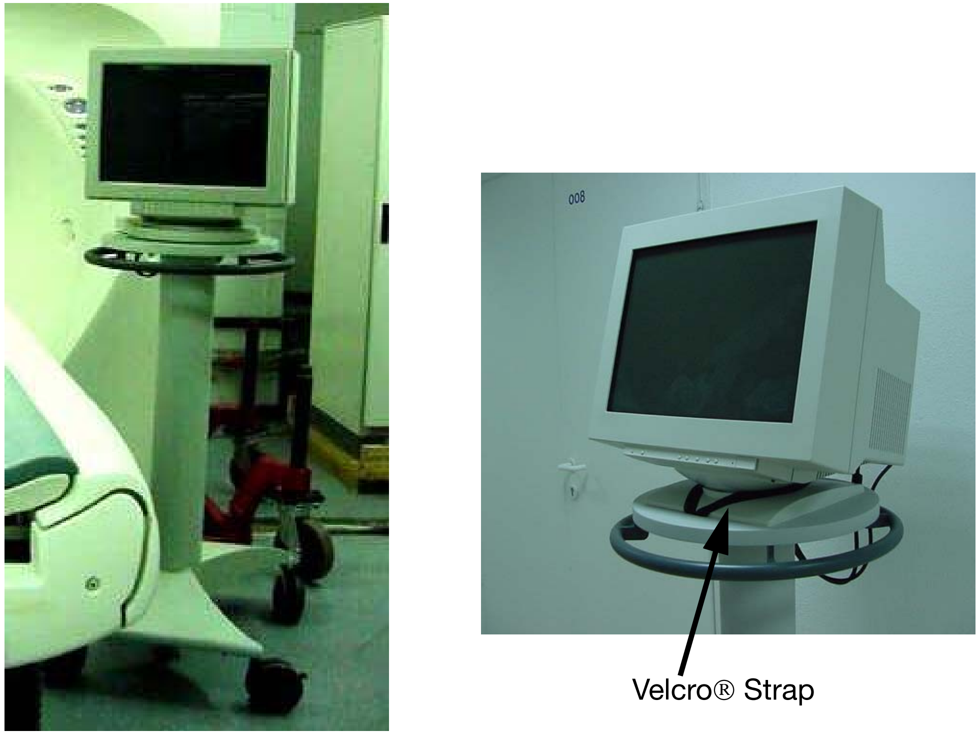


Figure 10-33: Cart Monitor Assembly

4. Fasten the monitor to the cart with the Velcro® strap as shown in *Figure 10-34* to *Figure 10-38*.

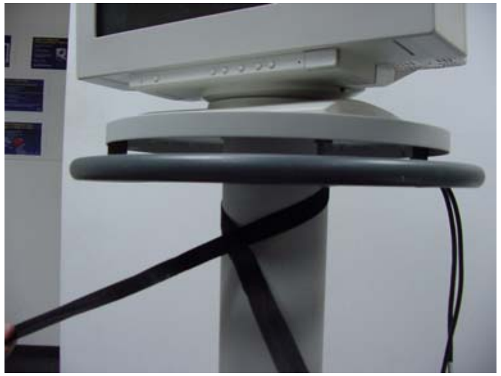


Figure 10-34: Wrap the Velcro® strap around the cart column. Make sure that both ends are of equal length.

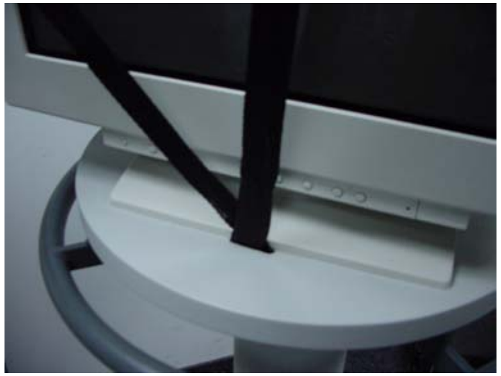


Figure 10-35: Thread both ends of the strap upwards through the forward slot.

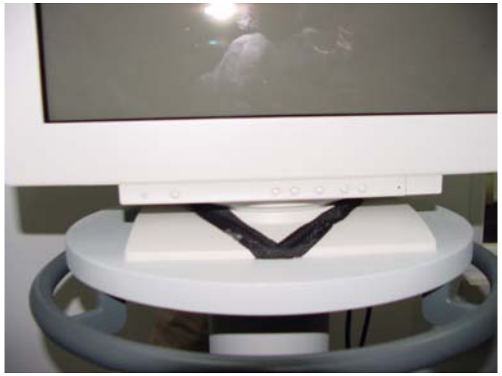


Figure 10-36: Pass both ends of the strap to the rear of the monitor

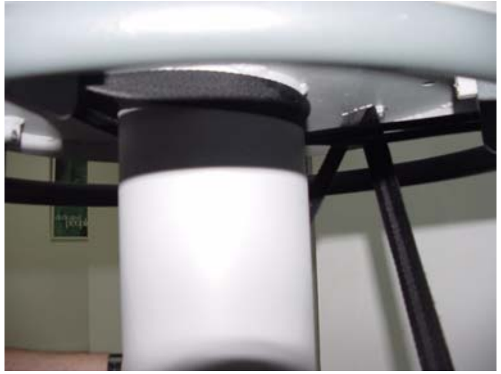


Figure 10-37: Thread both ends of the strap downwards through the rear slot

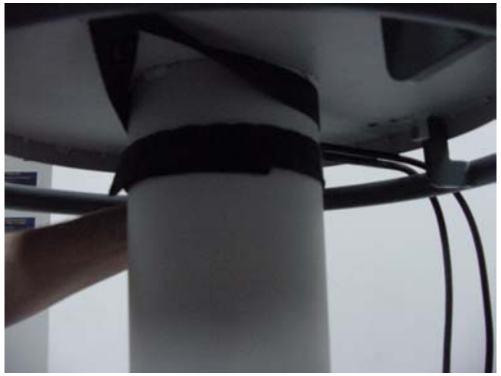


Figure 10-38: Wrap the ends of the strap around the cart column and adhere them together with the Velcro.

5. Locate the Power and Video Extension Cable and route it from the Gantry room to the Control room.

NOTE:

Cables should be routed using the existing ducts and troughs.

6. Connect the power and video cable to the cart (see *Figure 10-39*).
7. Connect the power cable of the monitor to the multi-outlet bank in the rear of the rack.

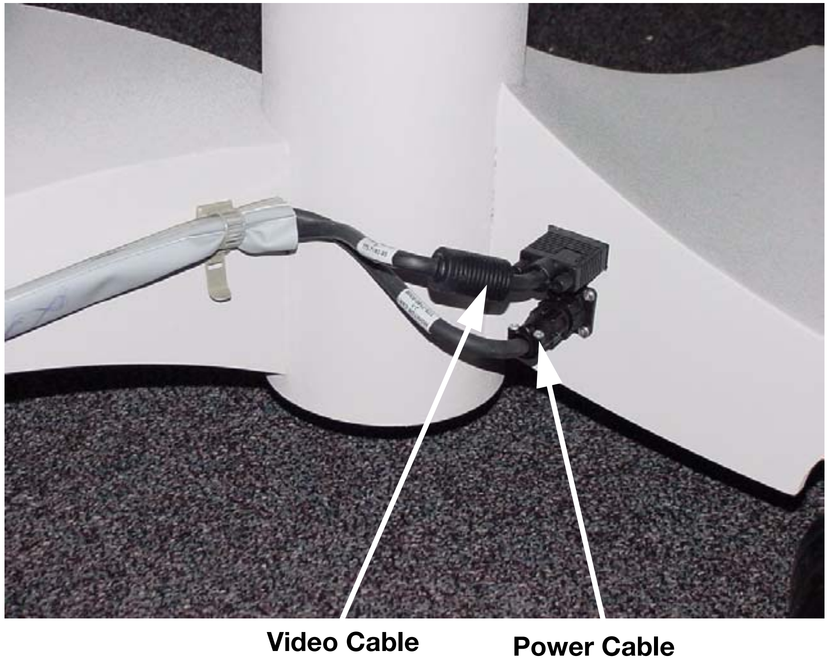


Figure 10-39: Cart Cable Connections

8. Connect the remote monitor cable (the cable that connects to the CCT monitor in the Gantry room) to the jack labeled "Data Display" on the video amplifier in the computer rack.
9. Turn the monitor ON and verify that it functions properly.

Final Checks

Verify the correct installation of the CCT option as follows:

1. Enter **Service**, **System Parameters**. In the **Configuration** window click **Scan Without X-ray.**
2. Enter the patient details. Click the **Abdomen** icon.
3. Choose the **Body Standard** protocol.
4. In **Protocol Parameters**, choose **Scan|Gating|Pedal**.
   Click **Yes** and **OK**.
5. Enter the scanner room and press the footswitch. Notice X-ray ON symbol on the flat panel CCT monitor is illuminated and that the buzzer is on.

In the event that the system does not respond:

1. Open the CANPro program.
2. Verify that when pressing the footswitch, a buzzer is sounded (the buzzer is located in the MCU board) and the following CANPro message appears:
   SF 00 01 Start Footswitch
3. If the message does not appear, check the footswitch connection.

Troubleshooting

1. If the footswitch does not operate, verify the connection between the MCU X11 and X313 (cable W358)(the left lower rear side of the Gantry) as follows:

MCU-RTC - X11 - Pin 5 --> Footswitch - X313 - Pin 1

MCU-RTC - X11 - Pin 9 --> Footswitch - X313 - Pin 3

2. When initiating the footswitch (in CCT protocols) a buzzer located in the MCU beeps during X-RAY ON. If it does not beep, verify that your MCU revision is AS06 or higher. If your board is Revision AS06 and the buzzer does not beep, replace the MCU board.

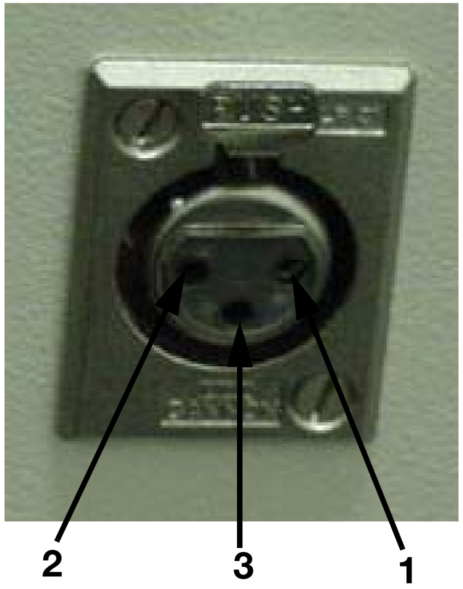


Figure 10-40: X313 Front View

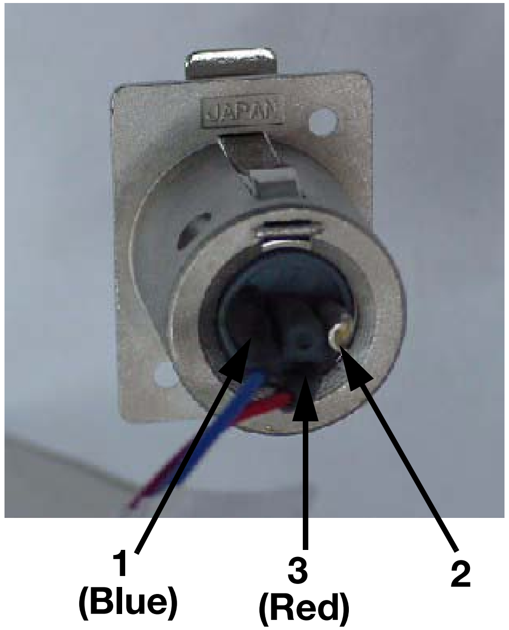


Figure 10-41: X313 Rear View

IRS Upgrade to 24 SHARCS

General

This document provides instructions on how to upgrade the Mx8000 Image Reconstruction System (IRS) to work with 24 SHARCS. This upgrade improves system performance and reduces reconstruction time by 25%.

This upgrade procedure includes installing additional hardware to the IRS, including the Expansion and PCI ILK cards.

NOTE:

The expansion card and the system card each have two revisions. The new revisions function identically to the old revisions, and can be used instead of them.

The PDQR Upgrade Kit contains new revision cards only.
This document describes the installation procedure for systems with both new and old system cards.

Parts

Table 10-3: PDQR Upgrade Kit P/N 480-7180-4909

DESCRIPTION	PART NO.
Expansion Card	CP718007022
PCI ILK Card	CP718007006
Upgrade Kit Installation Instructions (this document)	491-7180-7305A

Tools

Standard Service Engineer’s Tools Kit

Estimated Time

Three hours.

IRS Installation Procedure

System Setup

1. Switch OFF power to the computer rack and wait 20 seconds before moving the IRS.
2. Open the front cover of the computer and remove the IRS cover.

CAUTION:

⚠ CAUTION

USE AN ESD COPPER ANTI-STATIC WRISTBAND WHEN WORKING WITH SYSTEM COMPONENTS.

3. Remove the SCSI disk cable #W858 from the SYSTEM card.
4. Disconnect the ILK cable from the Expansion card, then remove the SYSTEM card from slot #2.
5. Remove the existing Expansion card from slot #5.
6. Install W6 jumper on the two Expansion cards (under Daughter card) (set clock enable) (see *Figure 10-43*).

Expansion Card (Old Revision)

Refer to *Figure 10-42*.

Table 1: Expansion Card D2 (Old Revision 900–07022)—Jumper Settings

JUMPER	USE OF THE JUMPER	WITH 24 SHARCS	WITH 16 SHARCS	PXB EEPROM PROGRAMMING
W1	Factory setting	OUT	OUT	OUT
W2	PXB Loading Source (out = load from EEPROM)	OUT	OUT	OUT
W6	Clock Select (In = Master)	OUT	OUT	IN

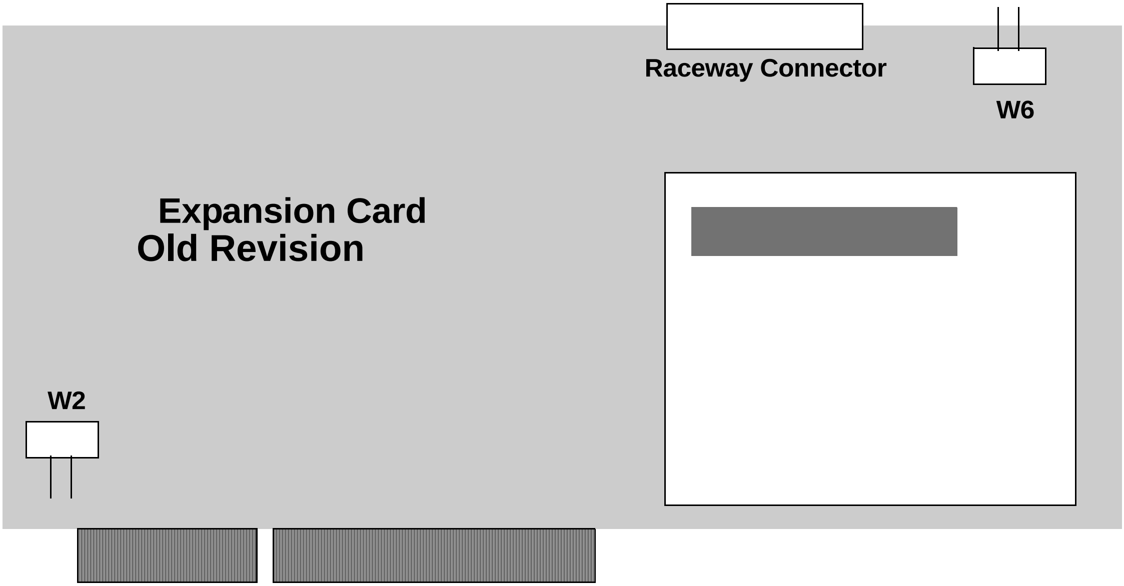


Figure 10-42: Expansion Card (Old Revision)

Expansion Card D2 (New Revision)

Table 10-4: Expansion Card D2 (New Revision)—Jumper Settings

JUMPER	USE OF THE JUMPER	WITH 24 SHARCS	WITH 16 SHARCS	PXB EEPROM PROGRAMMING
W2	PXB Loading Source (out = load from EEPROM)	OUT	OUT	OUT
W3	Xbar++ EEPROM Write Protect (out = protected)	OUT	OUT	OUT
W6	Clock40 Select (In = Master)	OUT	OUT	IN
W7	Drive clock On J1 (IN = Drive the Clock)	OUT	OUT	OUT
W8	Xbar++ Loading Source (out= load from EEPROM)	OUT	OUT	OUT
W9	Xbar++ Register (out = access)	OUT	OUT	OUT

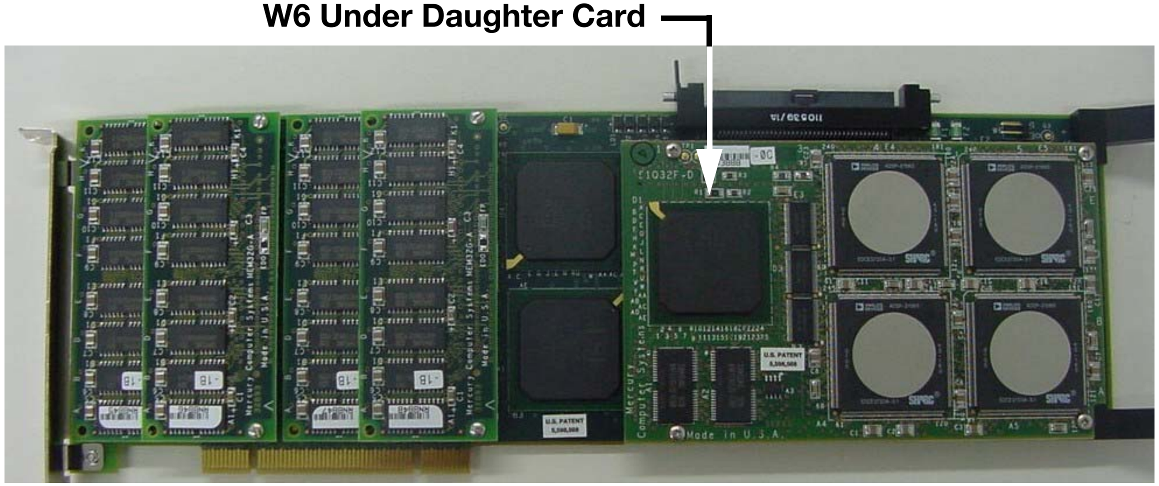


Figure 10-43: Expansion Card D2 (New Revision)

7. Move the PBB card from slot 6 to slot 7.
8. Re-install Expansion card 1 in slot 5.
9. Install the second Expansion card in slot 6.

Table 10-5: Slot Order in IRS

Slot No.	Card
1	Empty
2	System Card
3	Acquisitor
4	M.B. Controller
5	Expansion Card #1
6	Expansion Card #2
7	PBB
8	CIB

NOTE:

The system card must be removed from the slot before setting the expansion cards to the 16 MB Window size. (The next step).

Setting the Expansion Cards to 16 MB Window Size

1. First switch ON the IRS and then the O2.
2. Login as guest by typing **letmein** as the password.
3. **Open** the Unix shell from the Tool Chest.
4. Set special UNIX kernel with special MC drivers for setting the PXB EPROM by entering the following:
    a. Type: **su**
    b. Enter password: **pkserv99** and press **<ENTER>**.
    c. Type: **cp /usr/diamond.root/IRSbin/Utils/*.o /var/sysgen/boot/** and press **<ENTER>**.
    d. Type: **cd /** and press **<ENTER>**.
    e. Type: **/etc/autoconfig -fv** and press **<ENTER>**.
    (This step takes a few seconds—ignore the warning messages)
    f. Type: **init 6** and press **<ENTER>**.

    The system now reboots.

5. Login as guest by typing **letmein** as the password.
6. Open the Console window and from the Toolchest, select **SYSTEM| UTILITIES** and **START NEW CONSOLE.**
7. Open the Unix shell and enter the following:
    a. Type: **cd /usr/diamond.root/IRSbin/Utils/** and press **<ENTER>**.
    b. Type: **ls** and press **<ENTER>.**
    c. Type: **irix_pcixb_prom_read** and press **<ENTER>**.
    On the console terminal verify that the two lines contains the string: **Original PROM content 0x8806E6.** This line indicates that the system is running a 64 MB window size. (Configured at 16 SHARCS)
    d. Type: **irix_pcixb_prom_16Mi** and press **<ENTER>** (wait **one minute** until completion of PROM programming).
    e. Type: **irix_pcixb_prom_read** and press **<ENTER>**.
    On the console terminal verify that the line contains the string: **Original PROM content 0x8808E6**. This line indicates that the system is running a 16 MB window size. (Configured at 24 SHARCS)

The system is now configured at 24 SHARCS.

8. Resume nominal UNIX kernel with nominal MCOS (**M**ercury **O**perating **S**ystem) drivers by entering the following:
    a. Type: **su** and press **<ENTER>**.
    b. Enter password: **pkserv99** and press **<ENTER>**.
    c. Type: **source /usr/diamond.root/Scripts/diamondsetvars** and press **<ENTER>**.
    d. Type: **cp $MC_ROOT_DIR/lib/$MC_HOST_DIR/*.o /var/sysgen/boot/** and press **<ENTER>**.
    e. Type: **cd /** and press **<ENTER>**.
    f. Type: **/etc/autoconfig -fv** and press **<ENTER>**.
    (This step takes a few seconds—ignore the warning messages)
    g. Type: **init 6** and press **<ENTER>**.

The system now reboots.

9. Shut down the 02 computer.
10. Switch OFF power to the computer rack.

Post Programming Procedure

1. On the **System** card remove jumpers W1 and W3.

System Card (Old Revision)

Refer to *Figure 10-44*.

Table 2: System Card D1 (Old Revision 900–07022)—Jumper Settings

Jumper	Use of the Jumper	With 24 SHARCS	With 16 SHARCS	PXB EEPROM Programming
W1	Clock Source (In = Master)	OUT	IN	IN
W2	PXB Loading Source (out = load from EEPROM)	IN	IN	----
W3	Drive Clock on JX1 (In = Drive the clock)	OUT	IN	----
W4	Drive Clock on JX2 (In = Drive the clock)	OUT	OUT	----
J100	Clock33 1-2 = enable, 2-3 = Gnd	1-2	1-2	----
J101	Daughter card attached (Its for JTAG only, out=yes)	OUT	OUT	----

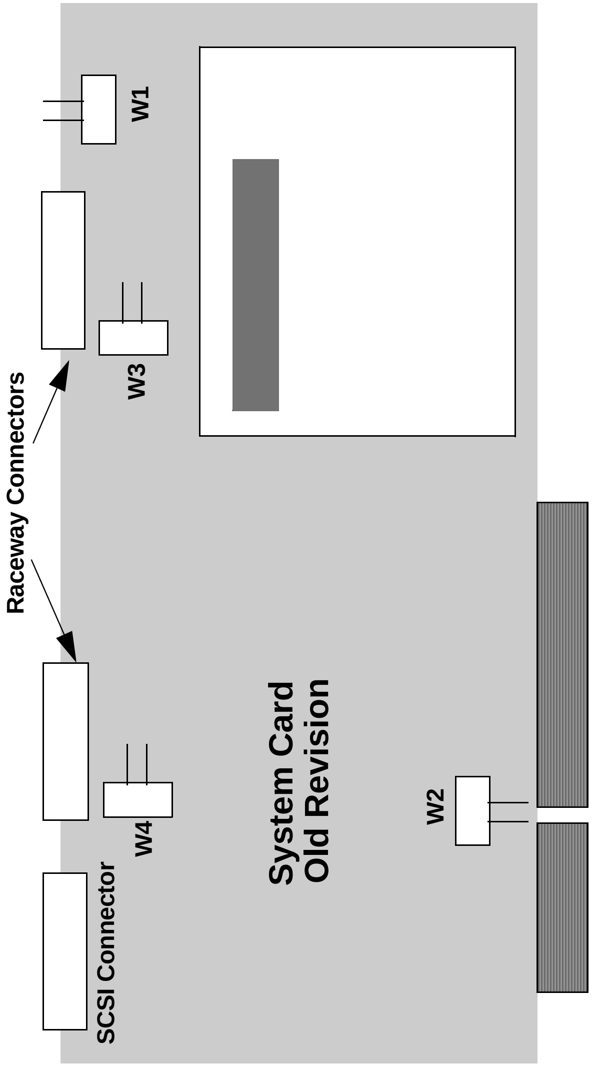


Figure 10-44: System Card (Old Revision)

System Card D1 (New Revision)

Refer to *Figure 10-45*.

Table 10-6: System Card D1 (New Revision)—Jumper Settings

Jumper	Use of the Jumper	With 24 SHARCS	With 16 SHARCS	PXB EEPROM Programming
W1	Clock40 Source (In = Master)	OUT	IN	IN
W2	PXB Loading Source (out = load from EEPROM)	IN	IN	----
W3	Drive Clock40 on JX1 (In = Drive the clock)	OUT	IN	----
W4	Drive Clock40 on JX2 (In = Drive the clock)	OUT	OUT	----
W6	Reset Board (In = Reset)	OUT	OUT	----
W500	Xbar++ Loading Source (out= load from EEPROM)	OUT	OUT	----
W501	Xbar++ EEPROM Write Protect (out = protected)	OUT	OUT	----
W502	Xbar++ Register (out = access)	OUT	OUT	----
J100	Clock33 1-2 = enable, 2-3 = Gnd	1-2	1-2	----
J101	Daughter card attached (Its for JTAG only, out = yes)	OUT	OUT	----

NOTE:

No Programming is needed on System Card (Only on Expansions)

Memory buffer of system card should be 64 MB.

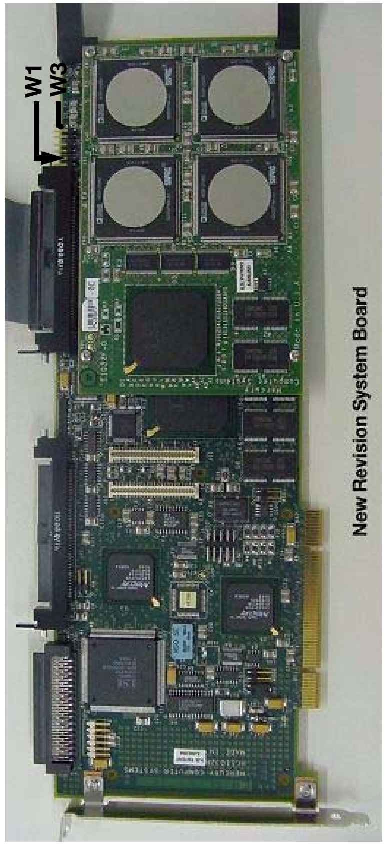


Figure 10-45: System Card D1 (New Revision)

2. Re-install the system card in slot 2.
3. Remove jumper W6 on **both** expansion cards.

PCI Link Card

1. Insert the PCILK4 card, connectors **CCON** and **BCON** to Expansion Card #1 and Expansion Card #2 cards respectively (see *Figure 10-47* and *Figure 10-48*).

NOTE:

Carefully align the connectors opposite the pins, to avoid bending the pins.

2. Screw the card in place with the four supplied screws (see *Figure 10-49*).

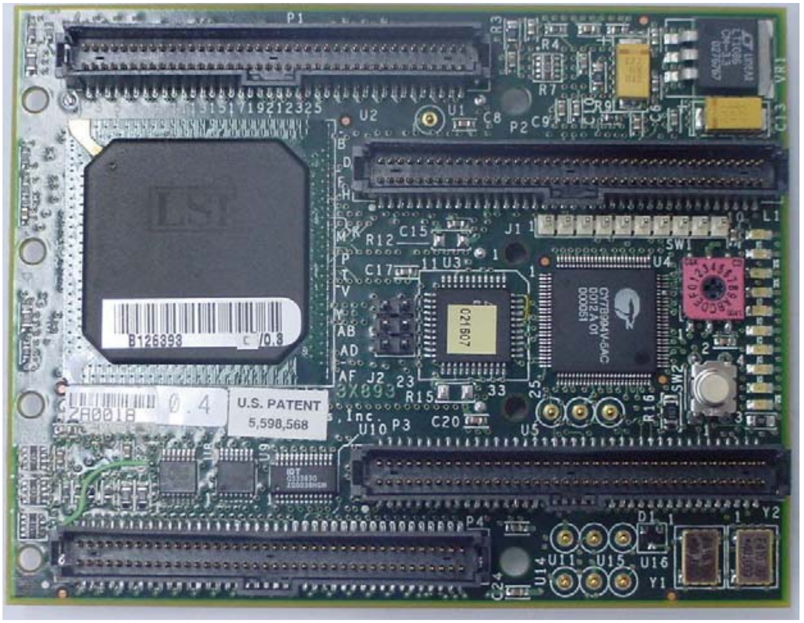
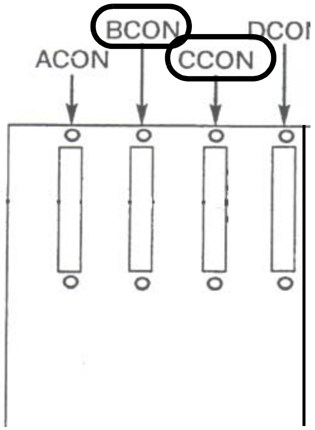


Figure 10-46: New Revision PCI Link Card

3. Connect the flat cable from J1 on the System card to connector J2-ECON on the PCILK4 card (see *Figure 10-48*).
4. Reconnect the W858 cable from the SCSI disk to the SYSTEM card.
5. Turn the computer rack ON. (IRS and O2)


BCON
DCO
ACON
CCON

4 Connectors Side of the Card

Figure 10-47: Location of CCON and BCON Connectors

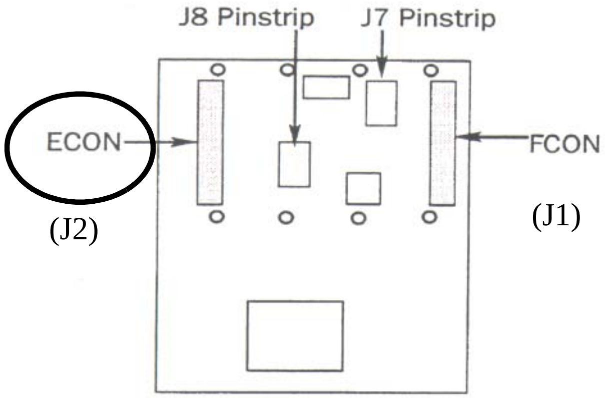

J8 Pinstrip
J7 Pinstrip
ECON
FCON
(J2)
(J1)

Figure 10-48: Location of ECON Connector

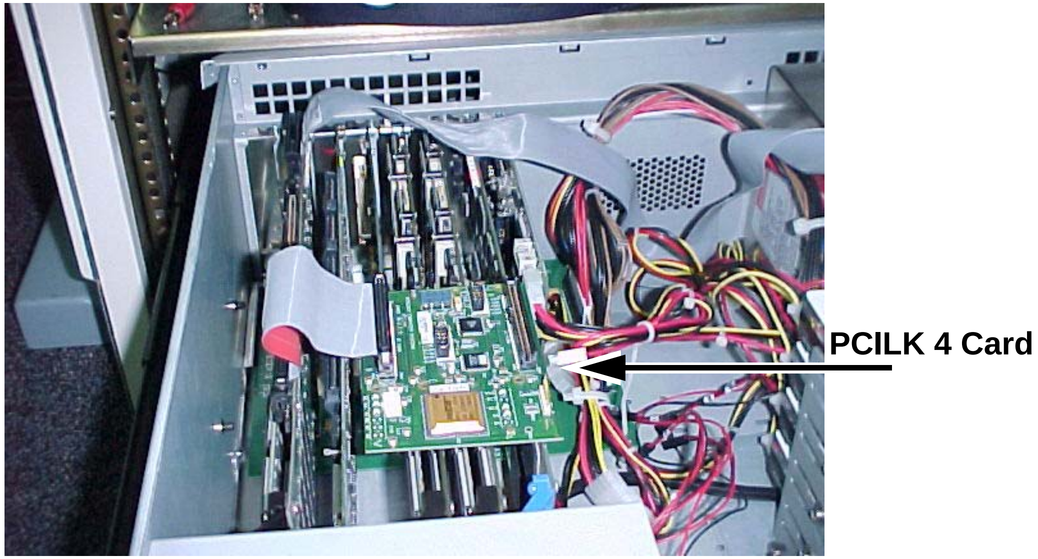

PCILK 4 Card

Figure 10-49: PCILK4 Card Location

MEM-8 Option

The MEM-8 option is used for upgrading the SGI-O2 memory of the Mx8000 scanner to a total of 1 GByte. The option consists of two 256 MB kits (total of 512 MB SDMx8000 and Mx8000 DualRAM). Each kit includes two 128 MB modules.

NOTE:

Installing the MEM-8 Option requires the removal of 64 MB of the computer's basic memory which was originally supplied with the O2.

Parts

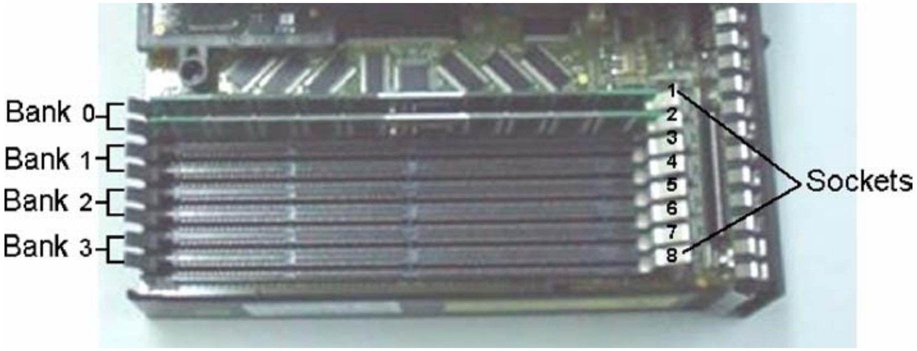
DESCRIPTION	PART NUMBER	QUANTITY
Memory Modules: 256 MB Upgrade Kit for O2	CP00070256C	2
MEM-8 Option Installation	491-7180-0805	1

Installation Instructions

O2 Memory Banks - General Description

The O2 computer includes slots for inserting 4 memory banks. Each bank consists of two slots - total number of 8 slots. Each memory kit is comprised of 2 identical memory modules, each kit should fit into one memory bank. The basic configuration of the Mx8000 scanner contains 576 MB memory. This memory is composed of 3 banks:

- Bank 0—256 MB (128 MB x 2)
- Bank 1—256 MB (128 MB x 2)
- Bank 2—128 MB (64 MB x 2)



Since the O2 computer can contain up to a limit of 4 banks of memory modules, to obtain a total amount of 1 GB, the following instructions should be included in the installation procedure:

- Removing the 64 MB kit.
- Installing the two 256 MB banks from the MEM-8 option kit.

The result is as follows:

- Bank 0—256 MB (128 MB x 2)
- Bank 1—256 MB (128 MB x 2)
- Bank 2—256 MB (128 MB x 2)
- Bank 3—256 MB (128 MB x 2)

Installation Procedure

1. Shut down the O2 computer.
2. Disconnect the O2 computer from its cables.
3. Wait for at least 2 minutes for internal capacitors to discharge before continuing to *Step 4*.
4. Take out the computer’s **CPU drawer** (system module)

⚠ CAUTION

USE ESD PROTECTION AT ALL TIMES WHEN HANDLING MEMORY MODULES.

5. Attache a wrist strap to your wrist and to the metal flange of the CPU drawer.
6. Remove the 64 MB memory kit out of the drawer. Each one of the modules is labelled **O2/32** and its modules edges are marked in yellow).
7. Insert the two MEM-8 option kits (total 512 MB) into the O2 computers now free banks.
8. Reassemble the CPU drawer. Reconnect the O2 computer and switch it ON.
9. Use the ***hinv*** command to verify that the O2 recognizes all the 1 GB memory correctly.
10. Change **MAX_SLICES** parameter to **700** as follows:
    a. Login as **root**.
    b. In the xterm window type: **cd /usr/usp.root/tamar/cfg/M**M<**Ente**r>
    c. Edit **mm_param** file by typing: jot mm_param<**Ente**r>
    d. Change the current line in the file: int MAX_SLICES = 512
    to: **int MAX_SLICES = 700**
    e. From the **File** menu, **Save** and **Exit** the jot editor.

21" Remote Slave Monitor Option

The 21" Remote Slave Monitor option enables the connection of the console monitor and up to three remote slave monitors to the O2. The remote monitors can be situated adjacent to the control room, e.g. in the doctors office.

NOTE:

The maximum distance between the computer rack in the console and the remote slave monitor is 40 meters.

The remote monitors display the same images as those that appear on the console monitor.

Safety Information

Only qualified and system trained Philips service staff is allowed to perform service (installation, maintenance, quality assurance) on the Mx8000 systems. Make sure that the latest version of the service instructions are available. Read the corresponding instructions carefully prior to working on the system. For your own safety and for more detailed safety information, refer only to the current version of the documents.

Use only specified tools and auxiliary materials.

Precautionary Measures Regarding Electrical Voltage

Before you start the procedure outlined in this manual, make sure that you read and understand the warnings listed below.

WARNING

PRIOR TO ANY SERVICE AND MAINTENANCE ACTIVITIES INSIDE COMPONENTS:

- **SWITCH OFF THE SYSTEM AT THE MAIN POWER SUPPLY, (USING THE ON-SITE ON-OFF SWITCH) AND THE INTERNAL/EXTERNAL UNINTERRUPTIBLE POWER SUPPLY (UPS)**
- **SWITCH OFF ALL EXTERNAL POWER, E.G. POWER FOR X-RAY WARNING LAMP.**
- **MAKE SURE THAT NO OTHER PERSON CAN SWITCH ON POWER OR SWITCH OFF THE SECURITY MEASURES, WHEN INSTALLATION, MAINTENANCE OR SERVICE WORK ON THE SYSTEM IS PERFORMED.**
- **PRIOR TO ANY INTERVENTION IN THE PDC, ALLOW AT LEAST FIVE MINUTES DISCHARGE TIME AFTER THE LAST SCAN. HAZARDOUS VOLTAGE LEVELS (>500V) MAY BE PRESENT EVEN IF THE SYSTEM IS SWITCHED OFF.**

After finishing any service activity, ensure that all covers of the Mx8000, including the mylar gasket, are closed.

WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN CHAPTER 1 OF THE MX8000 SERVICE MANUAL. FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

Tool Required

- Standard FSE tool kit

Estimated Time and Manpower

- Two hours
- One Person

Preface

This chapter instructs service personnel in the installation of the 21" Remote Slave Monitor option for the Mx8000.

The installation involves the following activities:

1. Installation of the video amplifier at the console
2. Monitor assembly and connection

Parts

Table 10-7: 21" Remote Slave Monitor Option Kit P/N 48071807506

ITEM	DESCRIPTION	P/N	QTY
17	Power Cable 1m	IC002601051	1
18	21" CRT Monitor	CP000521402	1
19	SVGA Video Cable 40m	77571809803	1
20	SVGA Video Cable 1m	77571809704	1
21	Installation Instructions	49171813907	1
22	Server Base	56571804436	1
23	Video amplifier	CP000503264	1
24	Video amplifier Clamp	56271809107	1
25	Video amplifier P.S. Clamp	56271809206	1
26	Nut NC 12	HN305001224	4
27	Screw NC12	HS01109608C	4
28	Cable Tie Mount	XW025000203	4
29	Self Locking Nut	HS12159406C	8
30	Cable Tie	XW025000012	4

The video amplifier and its power supply are mounted on a metal plate attached to the rack inside the console.   The video amplifier receives the video signal from the O2 computer. It has four output video signals that drive the:

- Console monitor
- 21" remote slave monitor
- Two additional remote monitors (optional)

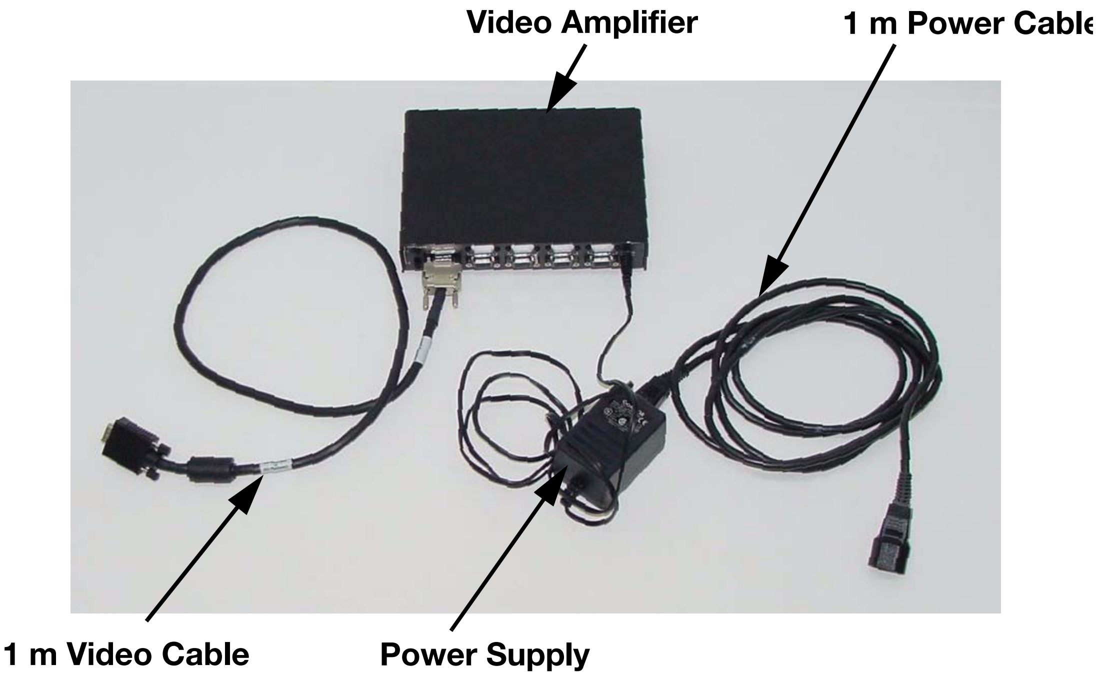

Video Amplifier
1 m Power Cable
1 m Video Cable
Power Supply

Figure 10-50: Video Amplifier Components

Video Amplifier Assembly

The video amplifier assembly contains the following elements:

- Server Base—metal plate for mounting the video amplifier and its power supply
- Video amplifier—video amplifier and its power supply
- Video amplifier clamp—metal cover that anchors the video amplifier to the server base
- Video amplifier Power Supply clamp—metal cover that anchors the video amplifier power supply to the server base
- Screw and Speed Nut (4 units)—to attach the server base to the rack of the console
- Cable Tie Mount and Self-locking screws—to fasten excess electric cable to the server base.

Assembly Procedure

The procedure describes the assembly and connection of the video amplifier to the server base, mounting of the server base to the rack in the console, and connection to the O2.

Server Base Assembly

1. Attach the cable tie mounts to the server base with the eight self-locking nuts. Insert the cable ties into the mounts. The cable ties secure the excess wire.
2. Assemble the video amplifier and its power supply to the server base with the clamps. Arrange the video amplifier so that 15-pin input jacks face the rear of the server base and that the power cable leading to the power supply faces the front of the server base.
   Each clamp has teeth on one side that are inserted into the rectangular holes in the server base, and a screw that fastens to the server base on the other side (see *Figure 10-51*).

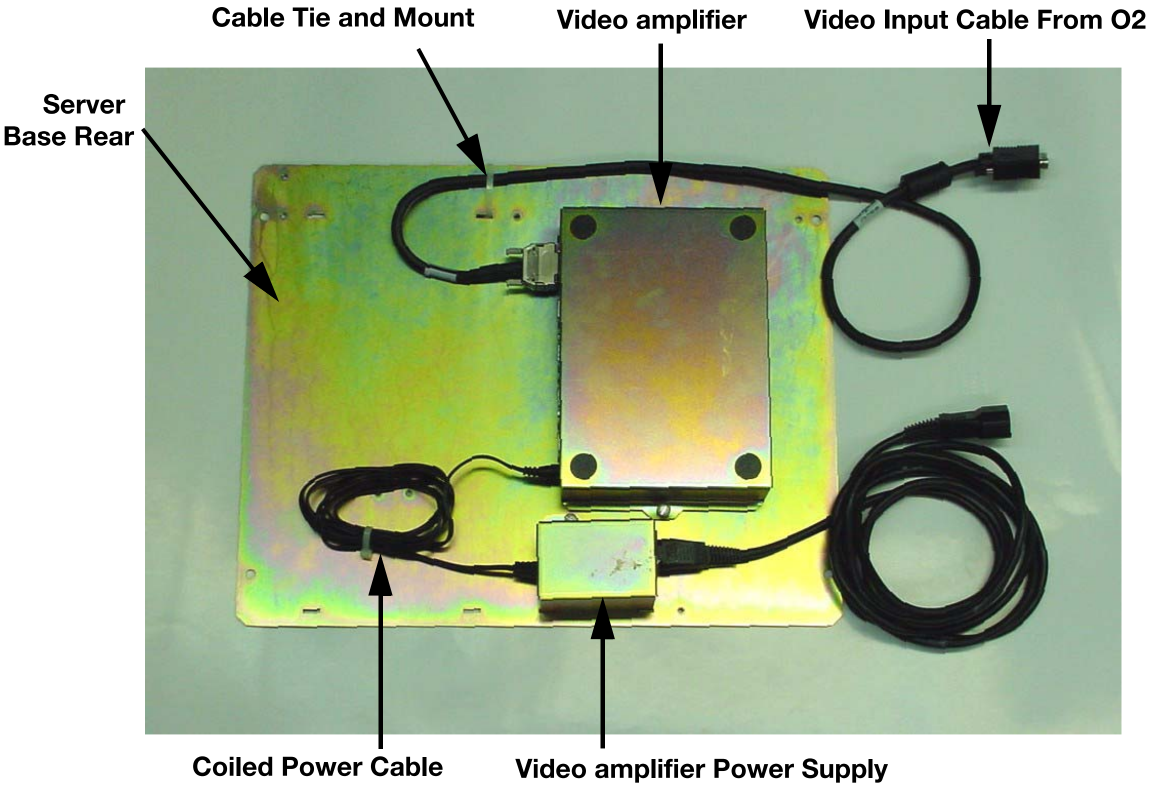

Cable Tie and Mount
Video amplifier
Video Input Cable From O2
Server
Base Rear
Coiled Power Cable
Video amplifier Power Supply

Figure 10-51: Server Base and Cable Ties

Server Base Mounting

1. Open the front panel of the computer rack.
2. Attach four nuts (u-nut type) to the vertical uprights in the computer rack so that they are parallel to the holes in each corner of the server base. Use the third hole from the top and the fourth hole from the bottom on the vertical upright. The nut wraps around the vertical uprights (see *Figure 10-52*).
3. Attach the server base with the four screws. The front panel of the video amplifier faces the front of the computer rack (see *Figure 10-53*).

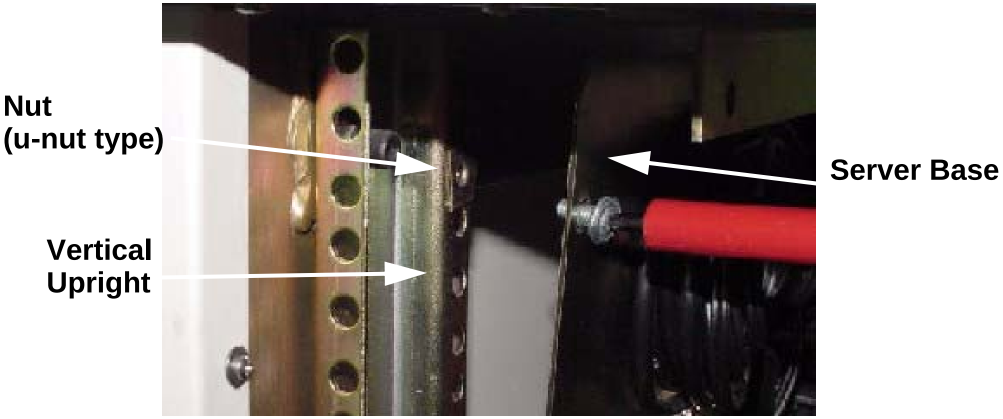

Nut
(u-nut type)
Vertical
Upright
Server Base

Figure 10-52: Server Base Mounting Procedure

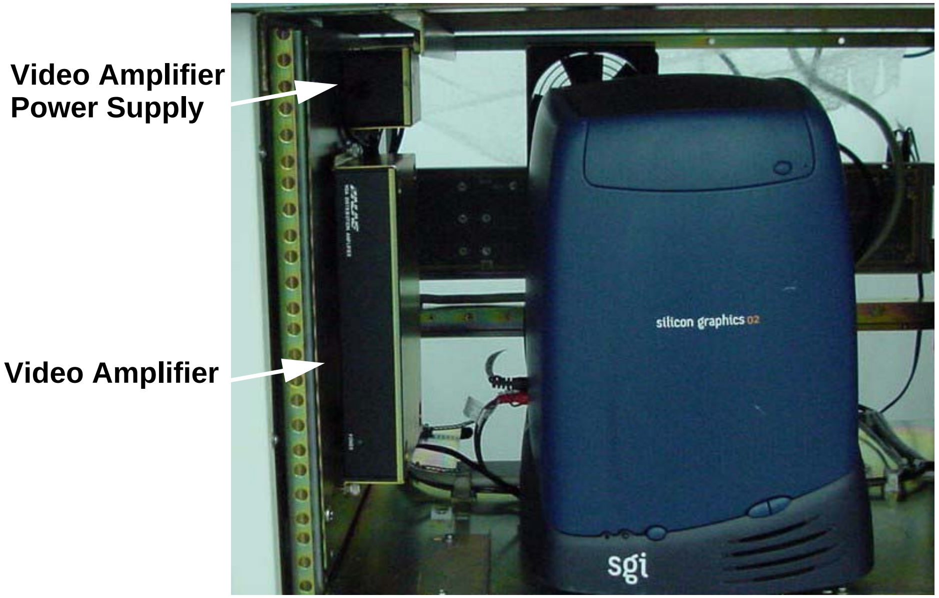

Video Amplifier
Power Supply
Video Amplifier
silicon graphics O2
sgi

Figure 10-53: Mounted Server Base

4. Detach the video cable from the rear of the O2 (see *Figure 10-54*).
5. Connect the 1m video amplifier monitor cable to the "Input" jack of the O2.
6. Connect the console monitor cable to the jack labeled "Onput 1" in the video amplifier (see *Figure 10-55*).
7. Connect the 40m video cable for the remote monitor to the jack labelled "Output 2". Connect cables for any other remote monitors (if present) to jacks labelled "Output 3" or "Output 4".
8. Connect the video amplifier power supply cable to the power supply and to the multi-outlet bank in the rear of the rack.

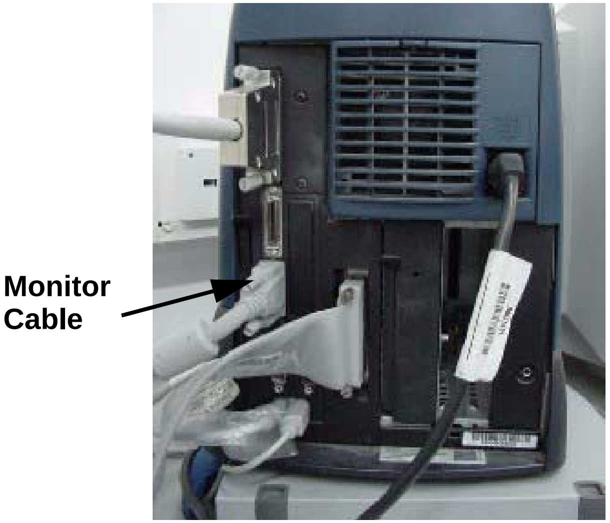

Monitor Cable

Figure 10-54: Rear of O2

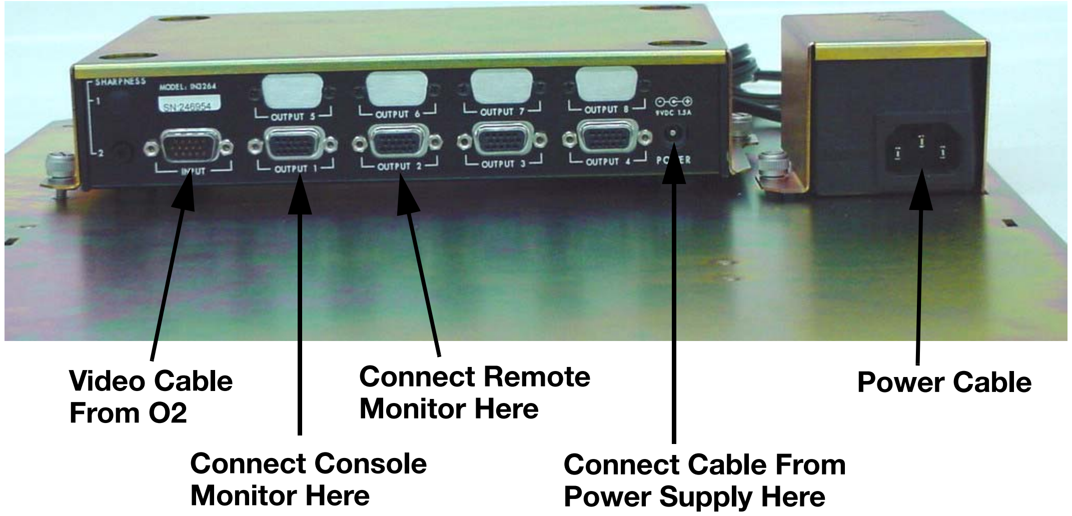

Video Cable From O2
Connect Console Monitor Here
Connect Remote Monitor Here
Connect Cable From Power Supply Here
Power Cable

Figure 10-55: Video Amplifier Connections

Remote Slave Monitor Assembly

1. Position the remote slave monitor in the desired location.

NOTE:

The maximum distance between the computer rack in the console and the remote slave monitor is 40 meters.

The video cable should be routed using the on-site ducts and troughs.

2. Connect the power cable of the remote monitor to the local power source.
3. Connect the 40m video cable to the video jack in the rear of the monitor.

UPS (Uninterruptible Power Supply) Option

The UPS (Uninterruptible Power Supply) option enables continuous power supply to the Operating Console and the Computer Rack for seven minutes in case of voltage drop or power failure. These seven minutes enable the operator to log out and shutdown the computer.

Parts

Table 10-1 lists the components that are included in the UPS option.

Table 10-1: UPS Option Components P/N BR71801500A

DESCRIPTION	PART NUMBER	QTY
UPS Unit - 1500 VA (with 2 holders)	BR71801500A	1
Bolts (inside the PDC)	Supplied with the PDC	4
Allen Screws	Supplied with the PDC	4

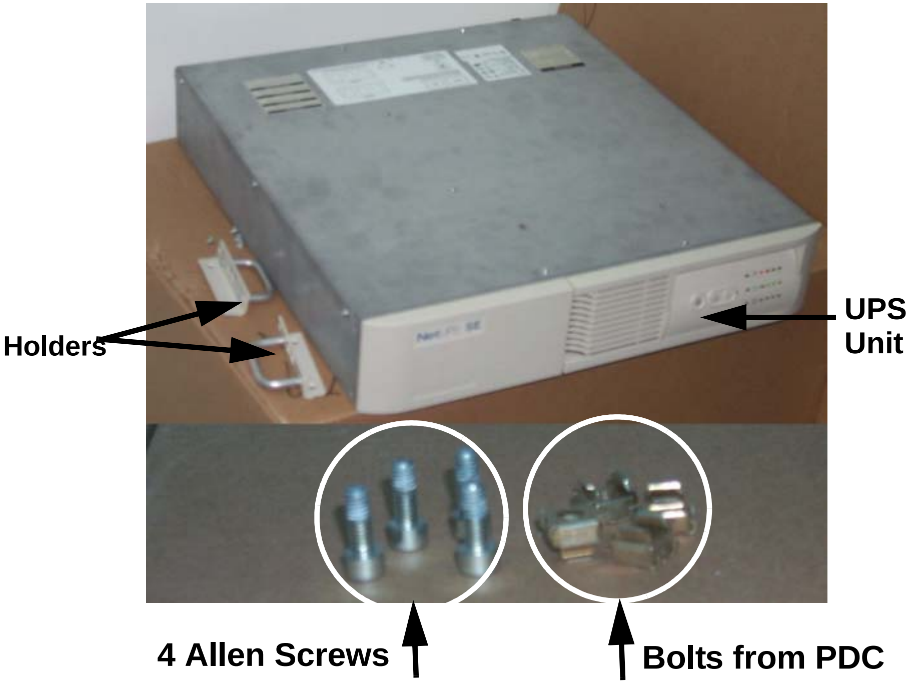


Figure 10-56: UPS Unit with Allen Screws and Bolts from the PDC

Tools

Standard FSE tool kit

Estimated Time

One and a half hours

Procedure

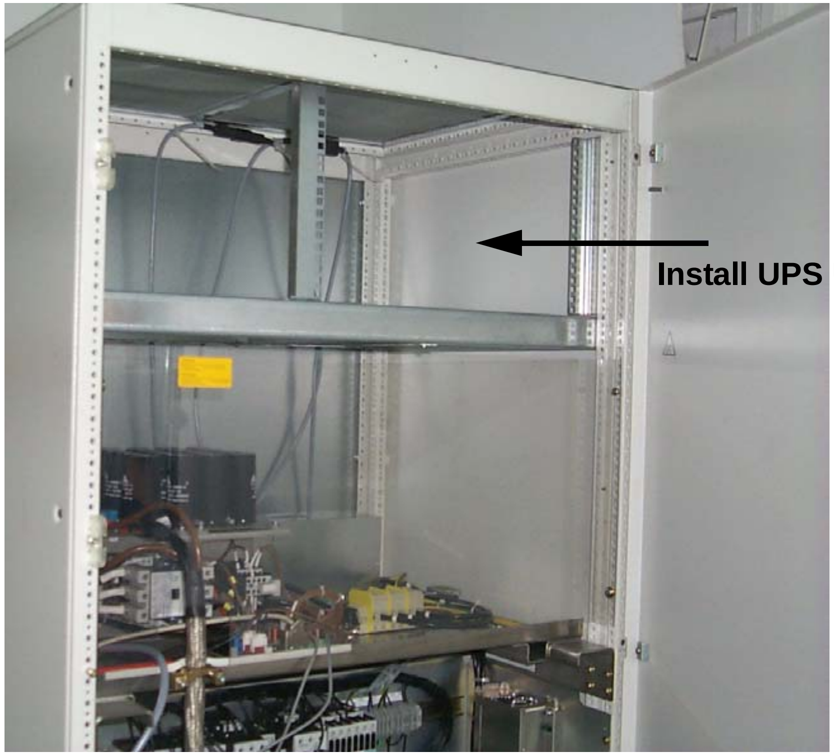


Figure 10-57: Location of UPS Unit

> **NOTE:**
>
> Remove the UPS unit from the PDC before transporting or shipping the PDC.

1. Switch OFF power by the switch located on the wall outlet.
2. Mount the two holders on both sides of the UPS unit (see *Figure 10-58*).

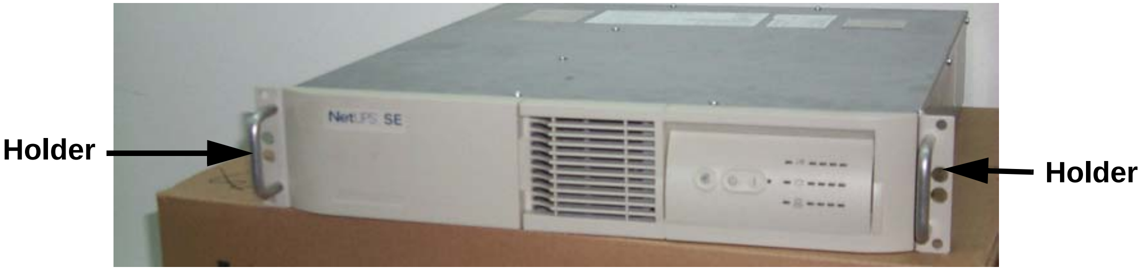


Figure 10-58: UPS Unit Showing Holders

3. In the PDC unit, disconnect the power cable - UPS-1 (see *Figure 10-59*).
4. Insert the bolts (as shown in *Figure 10-60*) on the rails of the PDC Unit, holes 1 and 6.
5. Slide the UPS assembly into the PDC frame.
6. Connect the female connector of UPS1 cable to the UPS rear panel connector, **INPUT**.
7. Connect the male connector of UPS1 cable to the UPS rear panel connector, **LOAD1**.

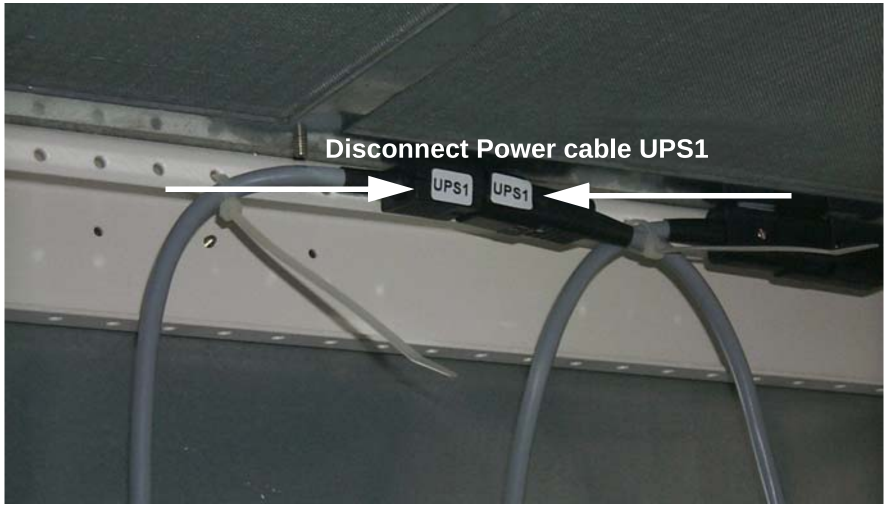


Figure 10-59: Power Cable in PDC Unit

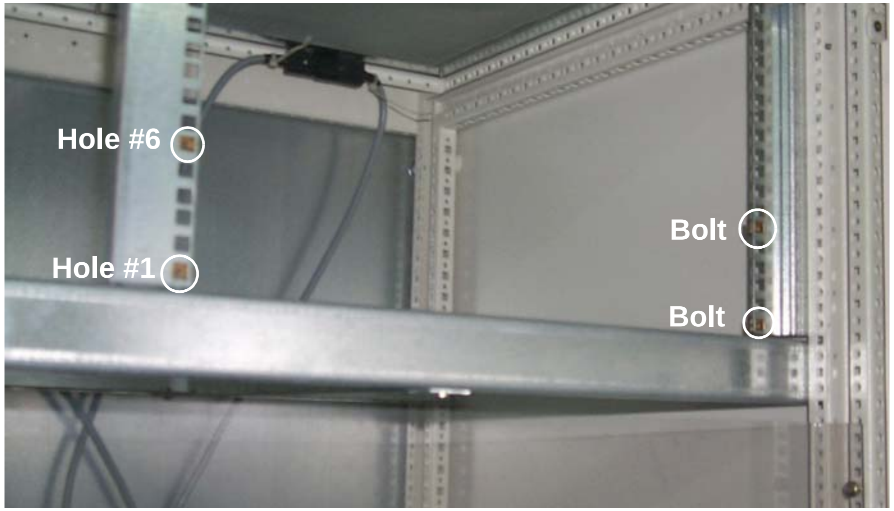


Figure 10-60: Inserting Bolts on PDC Rails

8. Secure the UPS assembly to the PDC frame with the four Allen screws (see *Figure 10-61*).
9. Switch ON power from the wall outlet.
10. Switch ON the UPS unit.
11. Switch ON power to the PDC unit.
12. Switch ON the Gantry and the computer.

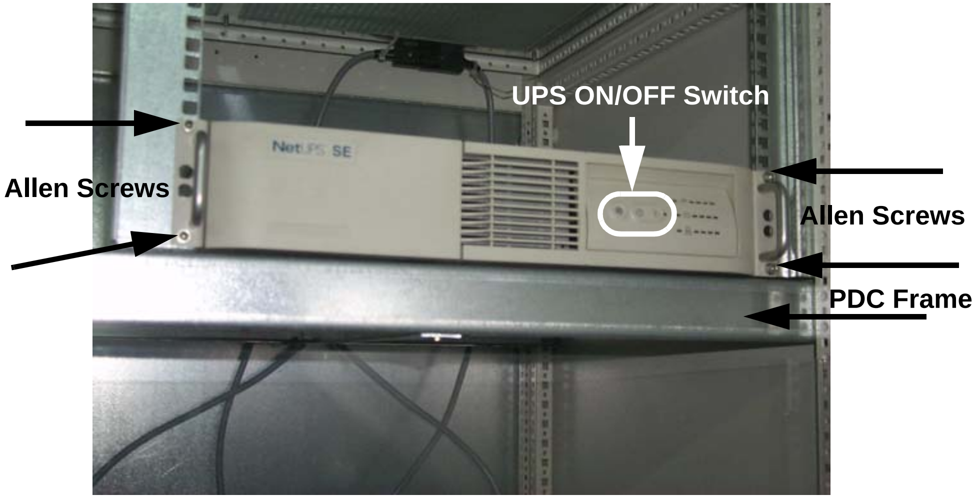


Figure 10-61: UPS Unit installed on the PDC

Tests

1. Wait three hours for the batteries in the UPS unit to recharge.
2. Switch OFF power from the wall outlet.
3. Check if the console continues to operate for seven minutes.

SAS (Spiral Auto Start)

SAS (Spiral Auto Start) is used in cases where timing between contrast injection and spiral scan is important. In such cases, SAS enables the automatic start of the spiral scan at a designated time after the beginning of the injection

The purpose of this document is to instruct the service engineer in the procedure required to install the SAS option for the Mx8000 systems.

⚠ WARNING

FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN CHAPTER 1 OF THE MX8000 SERVICE MANUAL. FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.

NOTE:

Make sure your system complies with the conditions described in *"Prerequisites"* before proceeding with installation.

Prerequisites

The SAS option for the Mx8000 supports **only the following injector models** produced by the manufacturers listed in the table below. Each model has its own specific prerequisites. In case the model does not comply with the prerequisites listed below, the customer must purchase and install the specific manufacturer upgrade kit.

Manufacturer	Model	Prerequisite	Means of Reference	Manufacturer Upgrade Kit	Manufacturer Purchasing and Contacts
MEDRAD	ENVISION	Software Version MCU 1.16 & DCU 1.14 and up **Check the configuration of the Envision CT Injector for Communicator as follows:** From the **Help** Screen, select **Configure System**. Select Page Down. To permit communication between the injector and the scanner, select **ON** for Communicator. When the Communicator is **ON**, a symbol appears on the **Protocol**, **Arming** and **Injecting** screens as shown below: is displayed if the interface is operational is displayed if the interface in not operational. When this symbol is displayed, a message to check Communicator settings appears and the Injector is disconnected. To operate the Injector in Stand-alone mode, set the Communicator to OFF. When the Communicator is ON, the Injector triggers the scanner to start the scan. The Communicator makes available a signal for the scanner anytime Scan Delay setting is 00:000, and Communicator is ON. Communicator accepts a signal from the scanner to initiate the injection once the injector is armed and Communicator is ON.	Displayed on power up	No. 3004102	1. See below

Manufacturer	Model	Prerequisite	Means of Reference	Manufacturer Upgrade Kit	Manufacturer Purchasing and Contacts
MEDRAD	VISITRON	Check the AutoLink option. The AutoLink option allows the injector to be interfaced with a CT scanner. This interface permits the injector to start the scanner.	Label on the rear of the unit	No.3003579	1. See Below
Liebel-Florsheim	CT 9000ADV	Universal Interface installed Firmware Version 2.04 and above	System firmware is displayed in **System Information** via the **Configuration** screen.	Universal Interface Kit P/N 800771	2. See below
Liebel-Florsheim	Angomat	This model includes the options		N/A	2. See below

- Medrad Contacts:
- European tech. support:

Frans Brandt
Tel. 31(43)358561
e-mail:
fbrandt@merdrad.com

- U.S. tech. support:

David Pommer
Tel. 412-767-2400 Ext. 3054
e-mail:
dpommer@medrad.com

- Liebel-Florsheim contacts:
- European tech. support:

Medicor
Attn. Alex Boeraeve
Timmerik 2
3020 Herent,
Tel. +32 16 271818; Fax: +32 16 224423
e-mail:
boeraeve.alex@village.uunet.be

- U.S. tech. support:

Mr. Jerry Newport
Tel. 513-948-5757
e-mail: jerry.C.Newport@mkg.com

- Liebel-Florsheim contacts:
- European sales director:

Dr. Michael Weissig:
Tel. 0031-736485313
e-mail:
Michael.Weissig@mkg.com

Tools

Standard FSE tool-kit

Time

Approximate time for installation is two hours.

Parts

The SAS Option Kit P/N 480-7180-2002 consists of the following:

INJECTOR TYPE	CABLE—PHILIPS P/N	QTY
Medrad **ENVISION**	775-7181-3201	1
Medrad **VISITRON**	775-7181-3300	1
Liebel-Florsheim **CT 9000ADV**	775-7181-3409	1
Liebel-Florsheim **Angomat**	775-7181-3508	1

Procedure

Connection of External Cable MCU/RTC X25 to the Injector

NOTE:

Cables must be routed through the system cable ducts.

The Mx8000 system supports four types of injectors (see *“Prerequisites”* for detailed information). Each injector requires a different cable (see *“Parts”*).

⚠ WARNING

TURN THE GANTRY OFF.

1. Remove the left side cover.
2. Connect the appropriate cable from the D-type 9 pin connector to the MCU/RTC board X25 connector.
3. Connect the appropriate cable (see *“Parts”*) to the following connectors in the injector:

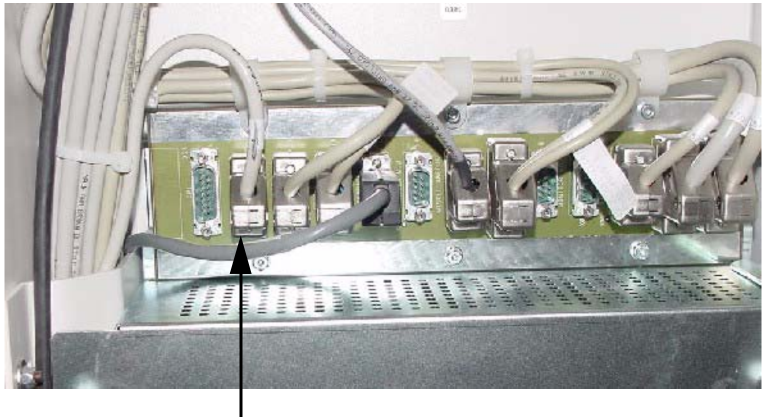


Figure 10-62: MCU Board

Table 10-1: Injector Connectors

INJECTOR TYPE	INJECTOR CONNECTOR
Medrad **ENVISION**	J-107 (see *Figure 10-63*)
Medrad **VISITRON**	J-302
Liebel-Florsheim **CT 9000ADV**	J-3
Liebel-Florsheim Angomat	P-2

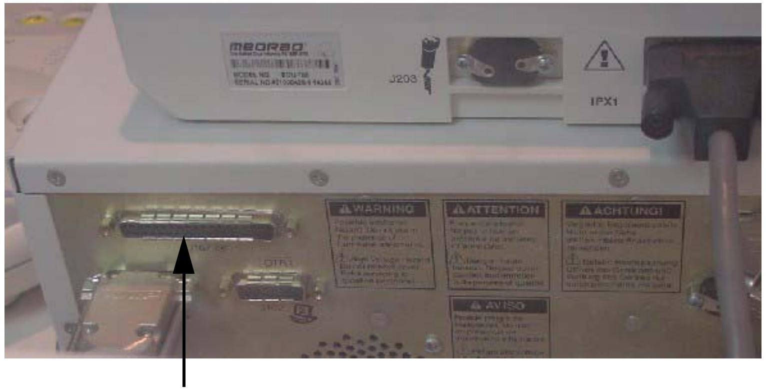


Figure 10-63: Rear Panel of Envision Injector

Medrad Envision Injector Test

Test Objectives

- Functional Check—verify that the injector triggers the scanner.
- Safety Check—verify that when the cable between the injector and the MCU board is disconnected the injector is disabled.

Test Plan

1. Functional Check
    a. Set the delay at the Injector console to 0.
    b. Define **Delay** to 10 sec on the SAS protocol.
    c. Wait for the message: **READY FOR SCAN**.
    d. Press on the **ARM** switch on the Injector.
    e. Press on the **START** switch on the Injector display console.

    The scanner starts the scan 10 sec. after the **START** switch is pressed.

2. Safety Check
    a. Disconnect the cable from connector J-107.
    b. Wait for the message: **READY FOR SCAN**.
    c. Arm the injector.
    d. The message **CANNOT ARM - IMPROPER SCANNER SIGNAL** is displayed.
    e. The scanner does not start the scan.

CANpro Verification

The purpose of this procedure is to verify communications between the injector and the host (scanner) via CANpro.

1. Open the CANpro program.
2. Verify that when pressing the **Start** key on the injector, the CANpro message **SF 01 01 .....** appears.

    If the message does not appear, check the cable connection.

Medrad Visitron Injector Test

Test Objectives

- Functional Check—verify that the injector triggers the scanner.
- Safety Check—verify that when the cable between the injector and the MCU board is disconnected the injector is disabled.

AutoLink Test

The purpose of the Autolink interface is to activate the scanner from the injector.

The P151 message is displayed on the control panel when the cable is installed for the first time and the Autolink option is installed. When the P151 message appears, press the Inject Mode key to enable Autolink. The P151 message code is cleared from the control panel and is not displayed again.

Test Plan

1. Functional Check
    a. Set the delay at the Injector console to 0.
    b. Define **Delay** to 10 sec on the SAS protocol.
    c. Wait for the message: **READY FOR SCAN**.
    d. Press on the **ARM** switch on the Injector.
    e. Press the **START** switch on the Injector display console.

    The scanner starts the scan 10 sec. after the **START** switch is pressed.
2. Safety Check.
    a. Disconnect the cable from connector J-302. The P152 message code appears and indicates that the cable has been disconnected from the connector.
    b. The P152 message code is displayed on the control panel when:

        - The cable is disconnected
          or,
        - The Injector is operational in stand-alone mode
          or,
        - Autolink is uninstalled
    - c. After the P152 message appears, press the Inject Mode key to confirm that Autolink is disabled. The P152 message code clears from the control panel.
    - d. The Injector may now be programmed and armed, but the Autolink feature is not available.
3. Message C570 indicates an error in communication between the scanner and the injector. If message C570 appears, do as follows:
    - a. Verify that the cable connection of the J302 connector (Visitron side) is securely installed.
    - b. Verify that the cable connection to the MCU board at X25 is securely installed.

    If the cable connections are secured and the C570 message persists, disconnect the Autolink interface and contact Medrad Service. The Injector is still operational but the Autolink does not function until service is restored.

CANpro Verification

The purpose of this procedure is to verify the communication between the injector and the host (scanner) via the CANpro.

1. Open the CANpro program.
2. Verify that when pressing the **Start** key on the injector, the CANpro message **SF 01 01 .....** appears.

    If the message does not appear, check the cable connection.

Liebel Florsheim CT9000 ADV Injector Test

Test Objectives

- Functional Check—verify that the injector triggers the scanner.

Test Plan

1. Functional Check
    a. Set the delay at the Injector console to 0.
    b. Define **Delay** to 10 sec on the SAS protocol.
    c. Wait for the message: **READY FOR SCAN**.
    d. Press on the **ARM** switch on the Injector.
    e. Press on the **START** switch on the Injector display console.

    The scanner starts the scan 10 sec. after the **START** switch is pressed.

CANpro Verification

The purpose of this procedure is to verify the communication between the injector and the host (scanner) via the CANpro.

1. Open the CANpro program.
2. Verify that when pressing the **Start** key on the injector, the CANpro message **SF 01 01 .....** appears.

   If the message does not appear, check the cable connection.

Liebel Florsheim Angomat Injector Test

Test Objectives

- Functional Check—verify that the injector triggers the scanner.

Test Plan

1. Functional Check
    a. Set the delay at the Injector console to 0.
    b. Define **Delay** to 10 sec on the SAS protocol.
    c. Wait for the message: **READY FOR SCAN**.
    d. Press on the **ARM** switch on the Injector.
    e. Press on the **START** switch on the Injector display console.

    The scanner starts the scan 10 sec. after the **START** switch is pressed.

CANpro Verification

The purpose of this procedure is to verify communications between the injector and the host (scanner) via the CANpro.

1. Open the CANpro program.
2. Verify that when pressing the **Start** key on the injector, the CANpro message **SF 01 01 .....** appears.
   If the message does not appear, check the cable connection.

Injector Cable and Wiring Diagrams

This section contains diagrams for the following cables:

- Medrad Envision
- Medrad Visitron
- Liebel-Florsheim CT 9000ADV
- Liebel-Florsheim Angomat

Cable Medrad Envision

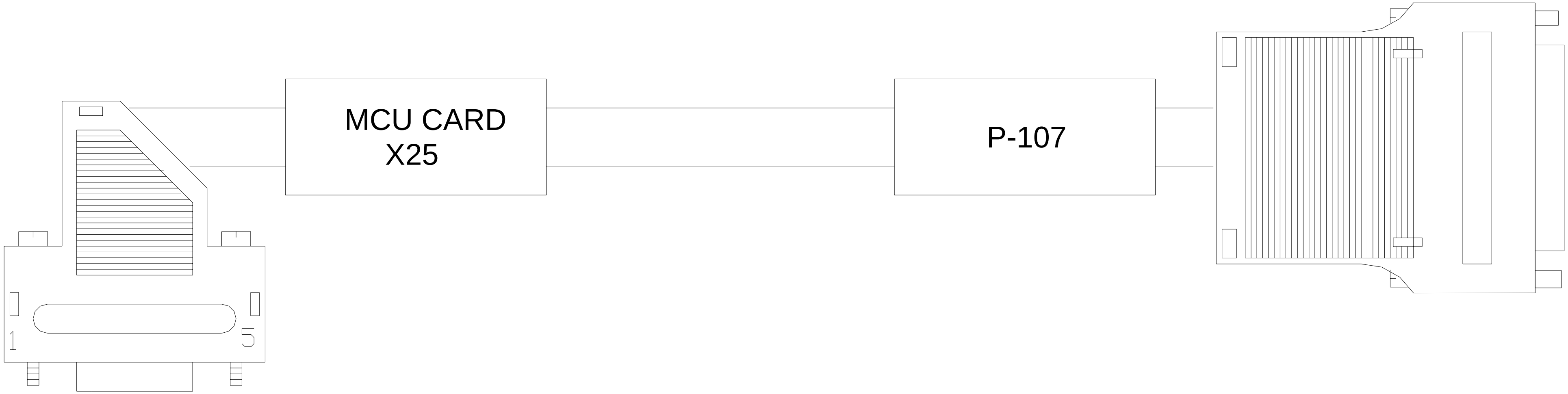


Table 10-2: Envision Cable Pin Layout

MCU CARD X25	COLOR	PHILIPS INTERFACE
2	Black	Injector Pos. 10
6	Red	Injector Neg. 22
<	White	Injector Disarm16
	Green	Injector Disarm25

Cable Medrad Visitron

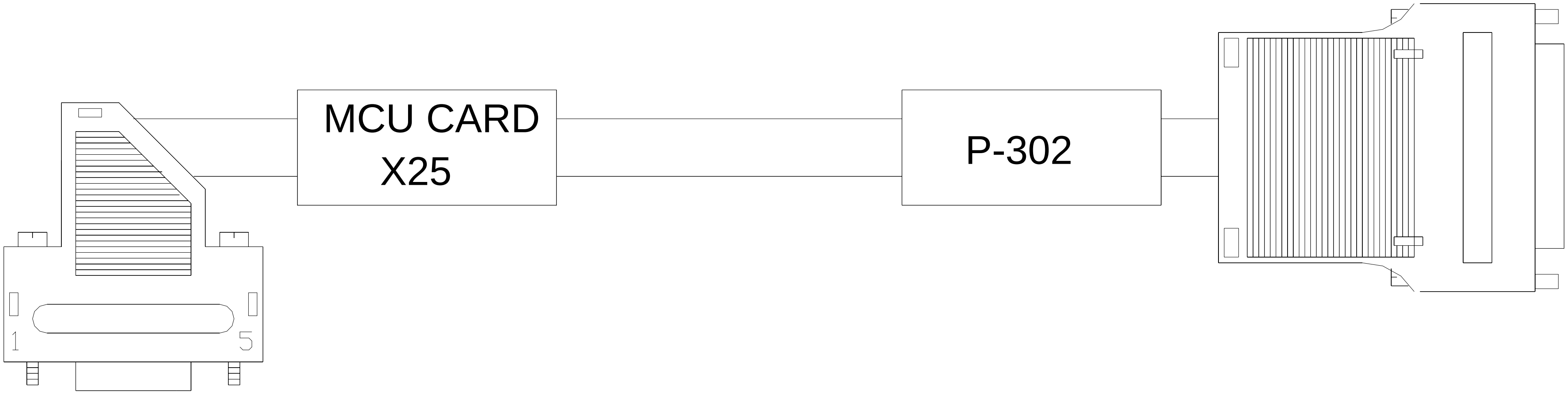


Table 10-3: Visitron Cable Pin Layout

MCU CARD X25	COLOR	P-107 CONNECTOR
2	Black	Injector Pos. 8
6	Red	Injector Neg. 9
<	White	Test_out 13
	Green	Test_out 25

Cable Liebel-Flarsheim CT 9000ADV

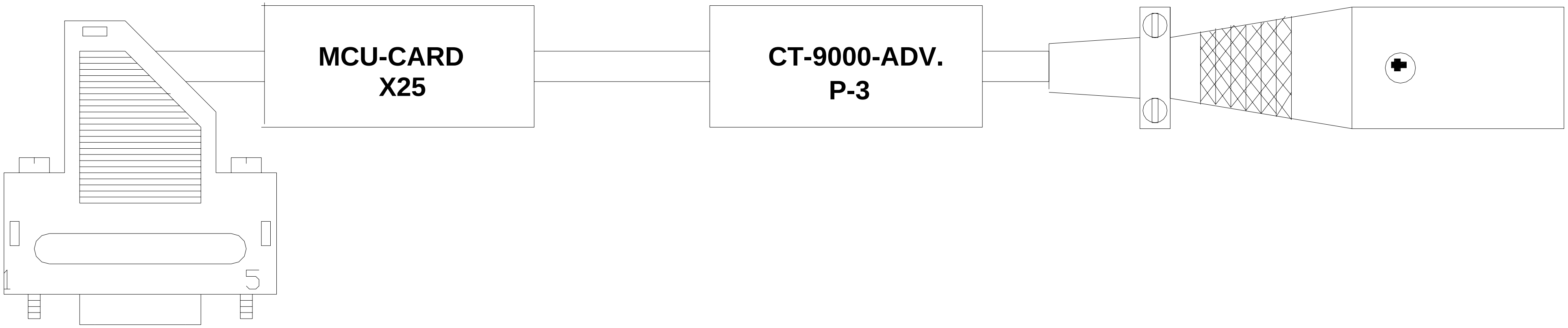


Table 10-4: CT9000ADV Cable Pin Layout

MCU CARD X25	COLOR	P-3 CONNECTOR
2	Black	Injector Pos. 3
6	Red	Injector Neg. 4

Cable Liebel-Flarsheim Angomat

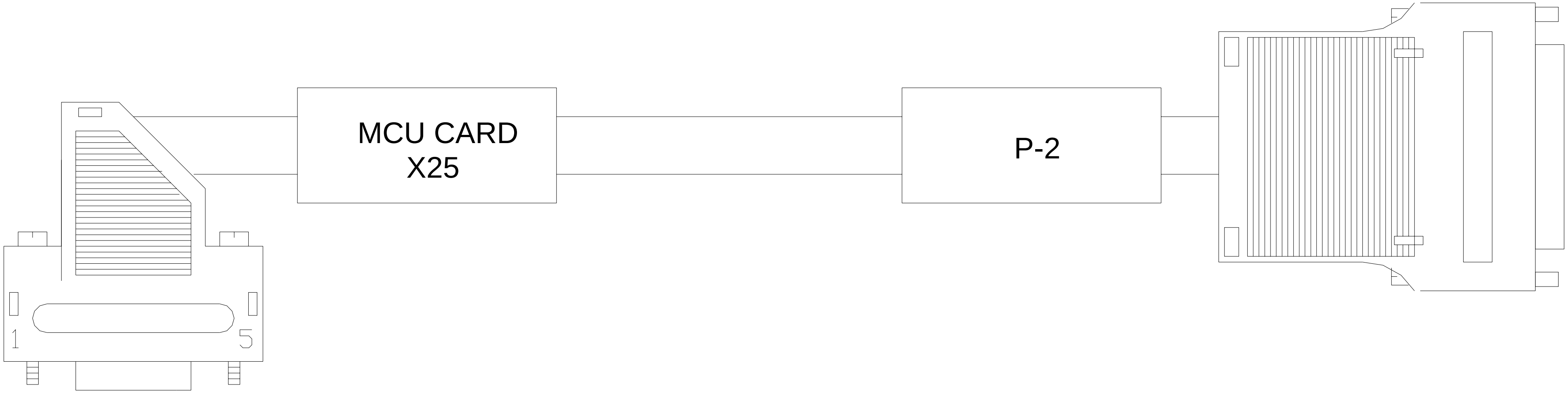


Table 10-5: Angomat Cable Pin Layout

MCU CARD X25	COLOR	P-2 CONNECTOR
2	Black	Injector Pos. 4
6	Red	Injector Neg. 5
<	White	Test_out 18
	Green	Test_out 1

Chapter 11
Stop Report

Stop Report 11-1

Introduction 11-1
Stop Report Loop 11-2
Overview 11-2
StopRepIn/Out loop 11-2
StopPos/Neg Circuit 11-2
System/MCB 11-5
Closing the Stop Report Loop 11-8
Opening the Stop Report Loop 11-9
The Stop Report Troubleshooting Kit 11-11
Bypass Connectors 11-11
Pin Layout (Short-Circuit Connectors) 11-12
Workstation 11-12
Rotor 11-12
Couch 11-13
GPC 11-13
PDC (D451+SLIO) 11-13
Gantry Stop Buttons 11-14
Slice Counter 11-14
XRS (Connector on W560 Cable 11-14
How to Use the CANpro Program to Locate the Defective Component 11-15
Analyzing the Results 11-17
Troubleshooting 11-18
Cables and Pin Layout 11-21
Installing the Troubleshooting Scenarios From the Diskette 11-22
Running the Scenarios 11-22
Stop Circuit-Details 11-23
Service Switches/Push Buttons 11-24
Troubleshooting Step-By-Step—Flowchart 11-27
Step 1: Checking the Workstation 11-27
Step 2: Checking the Rotor 11-28
Step 3: Checking the XRS 11-28
Step 4: Checking the Couch 11-29
Step 5: Checking the GPC Board 11-30
Step 6: Checking the PDC Board 11-31
Step 7: Checking the Stop Buttons 11-32
Step 8: Checking the Slice Counter 11-33
Step 9: Checking the MCU Board 11-34
Final Steps 11-34
Stop Report Checklist 11-35
Recommended Spare Parts 11-36

Stop Report Cable Pin Layout 11-37

Cable W51 11-38
Cable W51 11-39
Cable W52 11-40
Cable W351 11-41
Cable W362 11-42
Cable W364 11-43

Stop Report

Introduction

The purpose of this chapter is to help the service engineer solve the Stop Report (**error 12**) problem with a troubleshooting procedure.

This chapter contains the following sections:

- A general overview of the Stop Report Loop including circuitry and function descriptions
- A description of the Stop Report Troubleshooting Kit (P/N 407-7181-6903) including the kit’s contents and their functions in the troubleshooting procedure
- Prerequisites before starting the troubleshooting procedure
- A troubleshooting flowchart with step-by-step procedures

Stop Report Loop

Overview

The Stop Circuit is built up of two pairs of line going through the whole system:

StopRepIn/Out loop

The StopRepIn/Out loop reports the state and change of state to the Function Controller (opto-coupler) and allows the Function Controllers to interrupt the line, via relay contacts. In addition to the Function Controllers, the stop Buttons and an optional temperature sensor are included in this loop.

StopPos/Neg Circuit

The StopPos/Neg lines are used to enable/disable all movements such as:

- Gantry Rotation
- Gantry Tilt
- Patient Table In/Out
- Patient Table Up/Down

The Stop Report Loop is implemented to avoid any dangerous situation in the scanner and thus to ensure the patient’s safety. The Stop Report Loop is realized as a current loop. All 10 MCBs and the E-STOP buttons of the scanner are active parts of this loop. A passive part is the High Tension Enable in the generator.
This loop has to be CLOSED to reach the standby state and to enable the following functions:

- Generation of X-ray
- Gantry Rotation
- Gantry Tilt
- Patient Table In/Out
- Patient Table Up/Down

Each MCB is able to read the state of the Stop Report Loop (OPENED or CLOSED) and to OPEN the Stop Report Loop via a relay contact (see MCB function).

NOTE:

The Stop Report Loop is OPENED (no current) in the following cases:

- 5 V power supply out of tolerance on any of the MCBs
- STOP button pressed by the user (Scan Control Unit Gantry Control Panel)
- RESET button on a MCB pressed by the Service Engineer
- No trigger signals [MC1]for the Watchdog on a MCB
- Communication time-out in Abort activity only
- Each MCB, when detecting a safety related malfunction, OPENs its relay contact by firmware

As a result, the system is brought into a SAFE state by disabling Gantry Rotation, Gantry Tilt, High Tension, Patient Table In/Out and Up/Down. To disable the above-mentioned functions, the Stop Circuit controlling the line power supply (via solid state relays) is used (see *Figure 11-1*).

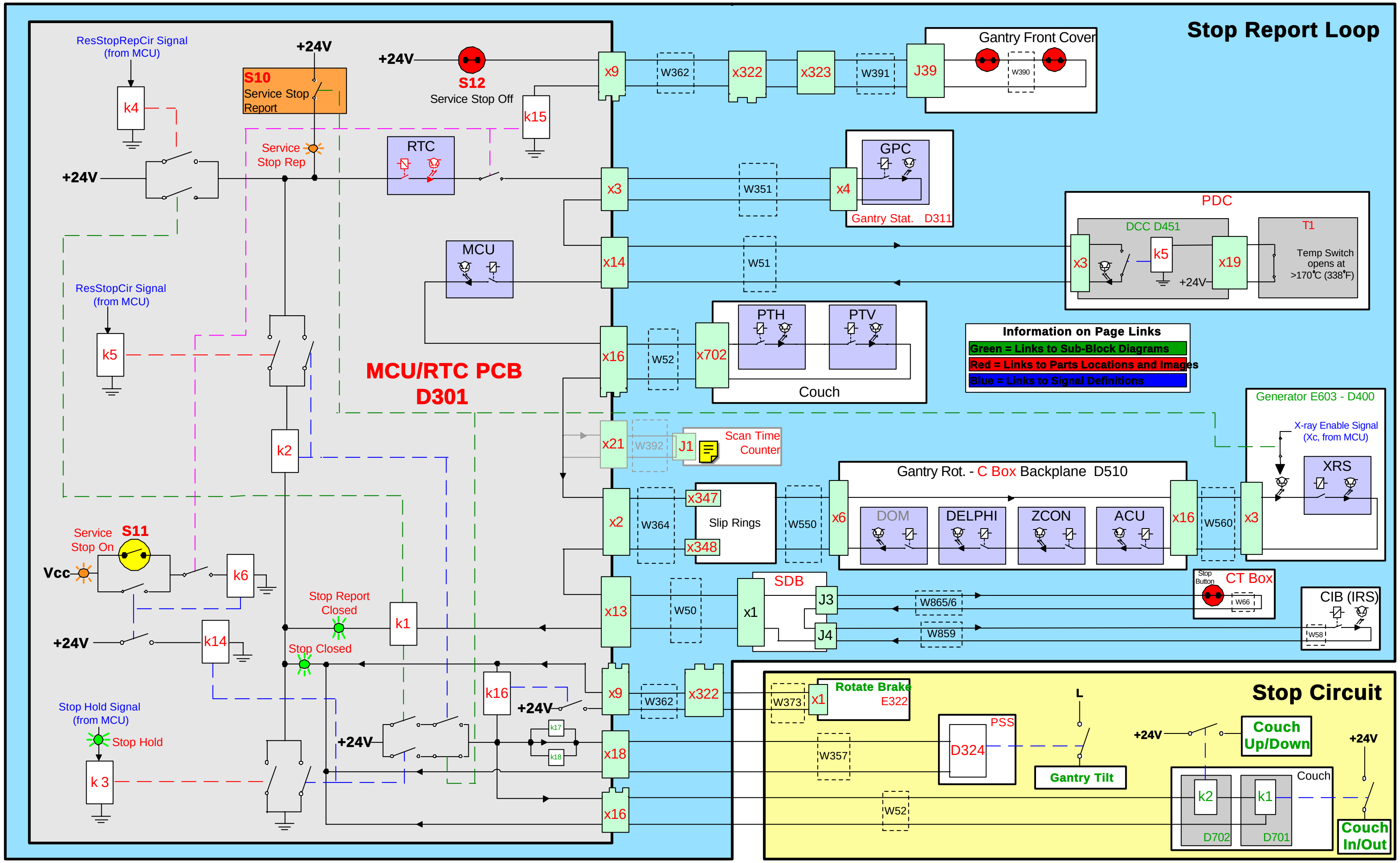

Stop Report Loop
ResStopRepCir Signal
(from MCU)
k4
+24V
S10
Service Stop
Report
+24V
S12
Service Stop Off
k15
Service
Stop Rep
RTC
+24V
MCU
ResStopCir Signal
(from MCU)
k5
MCU/RTC PCB
D301
k2
Service
Stop On
S11
Vcc
k6
+24V
k14
Stop Report
Closed
k1
Stop Closed
k16
+24V
k17
k18
+24V
Stop Hold Signal
(from MCU)
Stop Hold
k 3
x9
W362
x322
x323
W391
J39
Gantry Front Cover
W390
x3
W351
x4
GPC
Gantry Stat.
D311
x14
W51
PDC
DCC D451
x3
k5
+24V
x19
T1
Temp Switch
opens at
>170°C (338°F)
x16
W52
x702
PTH
PTV
Couch
Information on Page Links
Green = Links to Sub-Block Diagrams
Red = Links to Parts Locations and Images
Blue = Links to Signal Definitions
Generator E603 - D400
X-ray Enable Signal
(Xc, from MCU)
XRS
x21
W392
J1
Scan Time
Counter
Gantry Rot. - C Box Backplane D510
x2
W364
x347
Slip Rings
x348
W550
x6
DOM
DELPHI
ZCON
ACU
x16
W560
x3
x13
W50
x1
SDB
J3
J4
W865/6
W859
Stop
Button
CT Box
W66
CIB (IRS)
W58
x9
W362
x322
W373
x1
Rotate Brake
E322
Stop Circuit
L
PSS
D324
W357
Gantry Tilt
+24V
Couch
Up/Down
+24V
x18
x16
W52
Couch
k2
k1
D702
D701
Couch
In/Out

Figure 11-1: Stop Circuit Overview

System/MCB

This block diagram shows the principle of the D2, Micro Controller and Base (MCB) hardware board. The board is used as the function controller of the different Mx8000 components. The MCB board is built of the components listed in *Table 11-1*.

Table 11-1: MCB Board Components

COMPONENT	DESCRIPTION
Controller	8 bit micro controller, 16 MHz clock
CAN	CAN communications interface to connect the function controller to the CAN, Controller Area Network bus Via this path the communication to the Host or other function controller is done.
EPROM	EPROM memory of the micro controller system firmware
RAM	RAM memory used as working memory
FEEPROM	FEEPROM, Flash Electrical EPROM Memory of the application firmware (e.g. for the ZCO, DLP, MCU, etc.) FEEPROM can be erased by the micro controller using the signal Vppon, which switches on the Vpp=12 VDC supply. After that, new application firmware can be loaded from the Host WD.
Watchdog	To monitor the micro controller firmware and Vcc
Stop Circuit	**Stop Circuit is part of the Stop Report Loop of the Mx8000 system. Every Function Controller is able to OPEN the System Stop Report Loop if an error is detected or a corresponding command is received. The Stop Report Loop is normally CLOSED, but is OPENED in any of the following cases:** **• The controller sets StopControl** **• The Watchdog is not triggered** **• The RESET push button is pressed**

Table 11-1: MCB Board Components

COMPONENT	DESCRIPTION
StopRep Monitoring	**The condition of the Stop Report Loop is monitored through the StopReport input signal of the Function Controller.** **If the System Stop Report Loop is CLOSED, the current through the opto-coupler sets the StopReport input signal to HIGH.** **If a System STOP occurs, the input signal is set to LOW. This falling edge is recognized by the controller, which sets itself into a non dangerous condition.** **If the Stop Report Loop is CLOSED again (rising edge) the controller start a a RESET (i.e. start address 0, output RESET, CAN_Comm RESET, etc.).**
WHO	Since this Function Controller is used for different components in the system the WHO lines tell the controller its location (e.g. DLP, MCU, ZCO, etc.).
AN	The Function Controller has an internal 12 channel data acquisition system. Via the AN inputs the Function Controller can measure or monitor up to 12 analog signals.
V24/TTL	V24/TTL is the interface which could be used to connect a PC to the Function Controller.

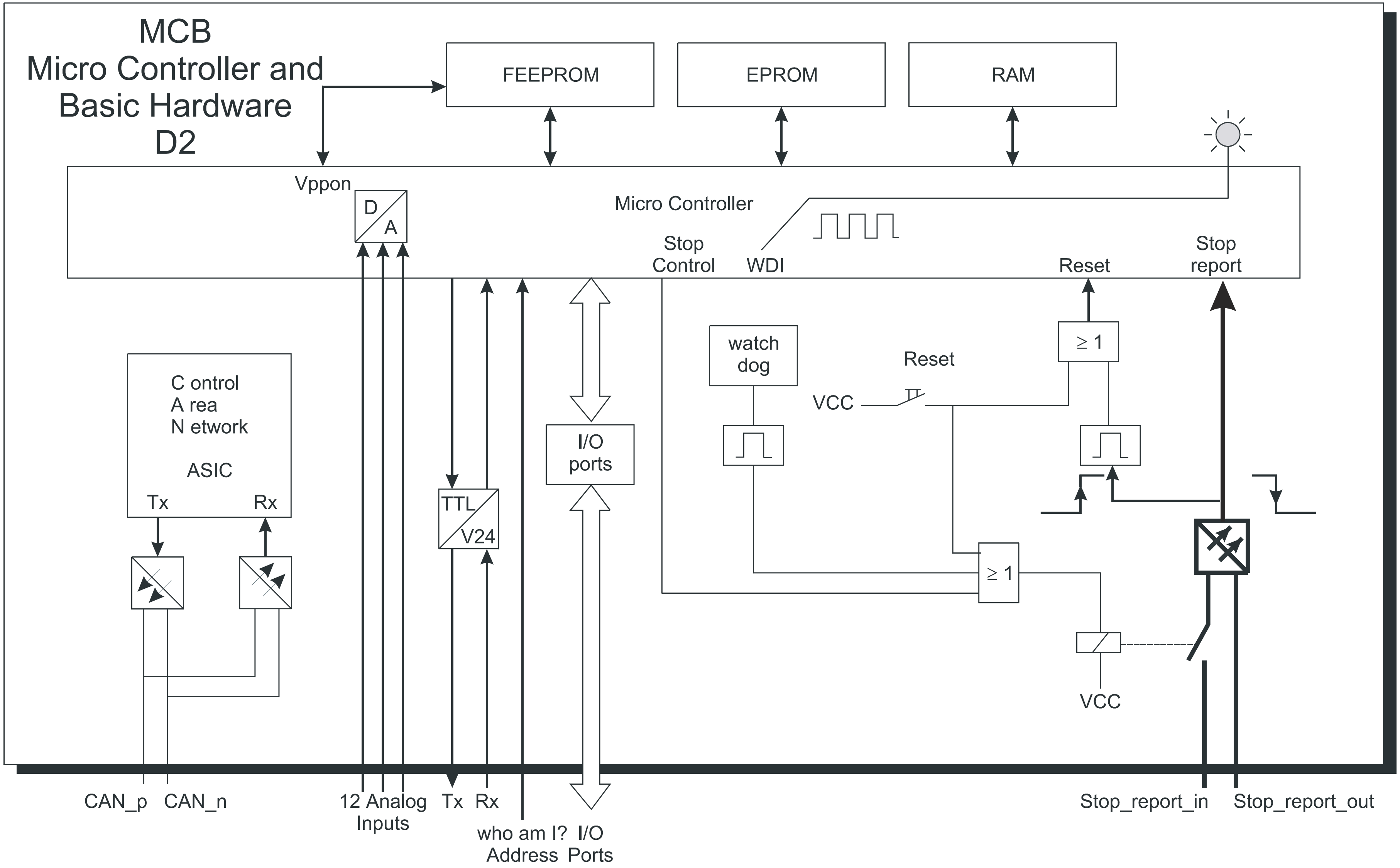

MCB
Micro Controller and
Basic Hardware
D2
FEEPROM
EPROM
RAM
Vppon
D
A
Micro Controller
Stop
Control
WDI
Reset
Stop
report
watch
dog
Reset
VCC
≥ 1
C ontrol
A rea
N etwork
ASIC
Tx
Rx
TTL
V24
I/O
ports
≥ 1
VCC
CAN_p
CAN_n
12 Analog
Inputs
Tx
Rx
who am I?
Address
I/O
Ports
Stop_report_in
Stop_report_out

Figure 11-2: MCB Overview (with highlighted StopRep)

Closing the Stop Report Loop

Each MCB closes its Stop Report Contact as soon as the system is powered on (see MCB function) if there is no malfunction detected. Whenever a RESET is performed, the system closes the whole Stop Report Loop in the following sequence see *Figure 11-1*):

1. The Host sends the RESET command via the CAN bus to the MCU, and from there to all MCBs.
2. The MCU sets Stop Hold to energize K3 and CLOSE the Safety Contact which provides GND to the Stop Report Loop and to the Stop Circuit.
3. ResStopRepCir is set for 100 ms and looped through all participants. The function controllers have closed the relay contacts in the INIT phase already.
4. K1 is energized and its self-holding contact is closed. K1 remains energized if ResStopRepCir is cleared.
5. Now there is a current flow in the Stop Report Loop. The Stop Report Loop is closed. With the raising edge of the current, all Function Controllers get a hardware reset.
6. After the start of the CAN communication, the MCU sets ResStopCir for 100 ms to enable the Gantry and Patient Table movements.
7. K2 is activated and its self-holding contact is closed. K2 remains energized if ResStopCir is cleared.
8. Through the now closed K1 and K2 contacts, 24 V is used to enable rotation, tilt and PHS movements by:
    a. Activating the D703 solid state relay in the PHS and connecting line power to the Couch Up/Down Circuit.
    b. Activating the D324 solid state relay in the Power Supply Stationary (PSS) which connects line power to the tilt frequency converter.
    c. Activating the K16 relay on D301 (which connects the output of the rotation frequency converter to the rotate motor, instead of the braking resistors) thus making rotation possible.

The Mx8000 is in the STANDBY state and all functions are now available.

Opening the Stop Report Loop

Whenever an MCB detects a safety related malfunction and opens its Stop Report Contact or when the Service Engineer presses an E-STOP button, the Stop Report Loop is interrupted and stays OPEN till the next RESET is performed.

As soon as the Stop Report Loop is interrupted, the High Tension is disabled, the self holding contacts of K1 and K2 drop. Through the Stop Circuit, power is disconnected from Couch In/Out, Up/Down Circuit, Gantry Tilt Circuit (D324) and instead of the output of the Rotation Frequency Converter, the damping resistors are connected to the Rotate Motor (RotBrakeCtrl). As a result, all movements are disabled immediately.

Table 11-2: Stop Report Signal

SIGNAL	DESCRIPTION
ResStopRepCir	ResStopRepCir is issued from the MCU through K4 during the RESET state for 100 ms to CLOSE the Stop Report Loop (K1).
StopHold	StopHold is issued from the MCU through K3 immediately after Power ON to close the ground connection for the Stop Report Loop.
ResStopCir	ResStopCir is issued from the MCU through K5 during the RESET state for 100 ms to CLOSE the Stop Circuit (K2).

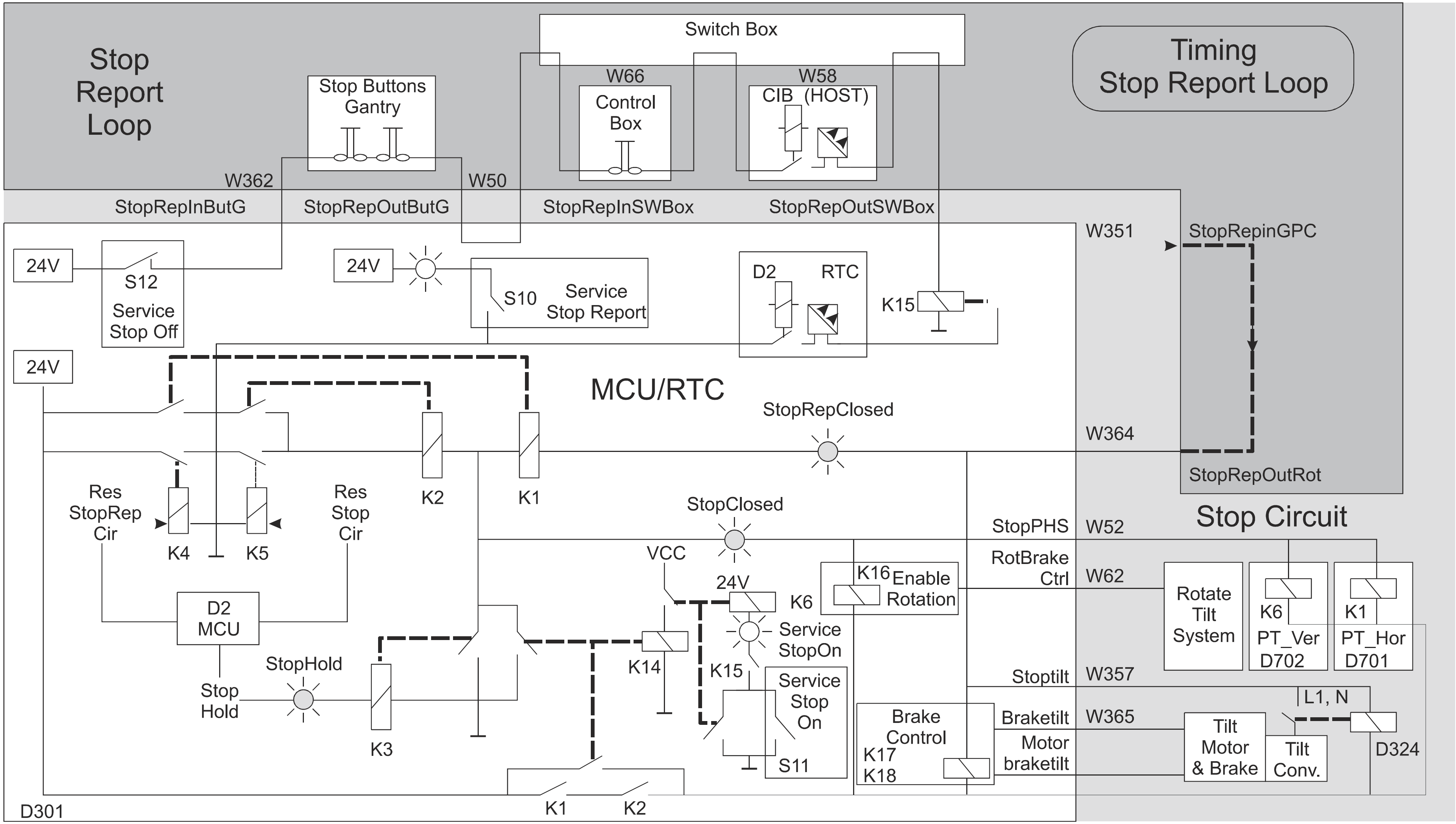

Stop Report Loop
Switch Box
Timing Stop Report Loop
Stop Buttons Gantry
W66
Control Box
W58
CIB (HOST)
W362
W50
StopRepInButG
StopRepOutButG
StopRepInSWBox
StopRepOutSWBox
W351
StopRepinGPC
24V
S12
Service Stop Off
24V
S10
Service Stop Report
D2
RTC
K15
24V
MCU/RTC
StopRepClosed
W364
StopRepOutRot
Res StopRep Cir
K4
K5
Res Stop Cir
K2
K1
StopClosed
Stop Circuit
StopPHS
W52
VCC
24V
K16
Enable Rotation
RotBrake Ctrl
W62
K6
Rotate Tilt System
K6
PT_Ver D702
K1
PT_Hor D701
D2 MCU
Service StopOn
StopHold
Stop Hold
K3
K14
K15
Service Stop On
S11
Stoptilt
W357
L1, N
Brake Control
K17
K18
Braketilt
W365
Motor braketilt
Tilt Motor & Brake
Tilt Conv.
D324
D301
K1
K2

Figure 11-3: Stop Circuit and Service -LEDs

The Stop Report Troubleshooting Kit

The Stop Report Troubleshooting kit is provided to aid in targeting faults in the system boards. The kit contents are as follows:

Table 11-3: Stop Report Troubleshooting Kit P/N 407-7181-6903

ITEM	DESCRIPTION	PART NUMBER	QTY
1	Bypass connectors kit	407-7181-2803	1
2	Scenario diskette	485-7181-0408	1
3	Stop Report Document	491-7181-3105	1

Bypass Connectors

The following table describes the bypass connectors supplied with the kit.

Table 11-4: Bypass Connectors

BYPASS CONNECTOR FROM STOP REPORT KIT	DEVICE	NUMBER OF PINS	GENDER
A1	Workstation	Sub-D, 50	Female
A2	Slipring+Rotor	Sub-D, 15	Female
A3	Couch	Sub-D, 9	Female
A4	GPC board	Sub-D, 9	Female
A5	D451+SLIO boards in PDC	Sub-D, 9	Female
A7	Gantry Stop Buttons	Sub-D, 15	Female
A8	Slice Counter	Sub-D, 9	Female
A6	XRS (D400)	Sub-D, 9	Male

Pin Layout (Short-Circuit Connectors)

Note: X1=Connector

Workstation

Table 11-5: Workstation

D-TYPE 50 FEMALE		
FROM	**TO**	**PIN NAME**
X1 /3	X1 /19	Stop Loop IRS (CIB)
X1 /2	X1 /6	R 180 ohm (CAN TERMINATION)

Rotor

Table 11-6:

D-TYPE 15 FEMALE		
FROM	**TO**	**PIN NAME**
X1 /2	X1 /4	Sync rs-sr-pos
X1 /7	X1 /14	Stop Loop Rotor
X1 /6	X1 /13	R 180 ohm (CAN TERMINATION)
X1 /9	X1 /11	Sync rs-sr-neg

Couch

Table 11-7:

D-TYPE 9 FEMALE		
FROM	**TO**	**PIN NAME**
X1 /3	X1 /7	Stop Loop Slice Couch
X1 /2	X1 /6	R 180 ohm (can termination)

GPC

Table 11-8:

D-TYPE 9 FEMALE		
FROM	**TO**	**PIN NAME**
X1 /3	X1 /7	Stop Loop Slice Counter
X1 /2	X1 /6	R 180 ohm (can termination)

PDC (D451+SLIO)

Table 11-9:

D-TYPE 9 FEMALE		
FROM	**TO**	**PIN NAME**
X1 /3	X1 /7	Stop Loop PDC
X1 /2	X1 /6	R 180 ohm (CAN TERMINATION)

Gantry Stop Buttons

Table 11-10:

D-TYPE 15 FEMALE		
FROM	**TO**	**PIN NAME**
X1 /8	X1 /15	Stop Loop Gantry Stop Buttons

Slice Counter

Table 11-11:

D-TYPE 9 FEMALE		
FROM	**TO**	**PIN NAME**
X1 /2	X1 /6	Stop Loop Slice Counter

XRS (Connector on W560 Cable

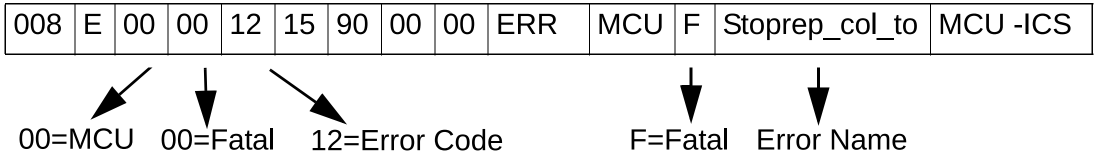
Table 11-12:

D-TYPE 9 MALE		
FROM	**TO**	**PIN NAME**
X1 /3	X1 /7	Stop Loop XRS
X1 /2	X1 /6	R 180 ohm (can termination)

How to Use the CANpro Program to Locate the Defective Component

The stop state is reached when TABLE LOAD is finished (after INIT start) or when the stop report line is open.

A STOP is detected by all components with high priority HW interrupts. With this interrupt, all components switch into STOP by bringing all functions to a safe condition. The error message that appears on the screen is as follows:



008	E	00	00	12	15	90	00	00	ERR	MCU	F	Stoprep_col_to	MCU -ICS

Use the following procedure if the error message is Stop Report but the error code is not 12. To determine the source of the stop report error, we can locate the defective controller by sending a telegram for each controller and then checking the status of each one.

Send the telegram as follows:

1. Click **Monitor | Monitor Stop**.
2. Click **Simulation | Send Telegram**.
3. Type: **0** in the **Identifier** text box.
4. Type: **U** in the **CAN command** text box.
5. Type in the code number for the desired controller (see *Table 11-13*) in the second bit (for example, type: **00** for MCU).
6. Click **OK**.

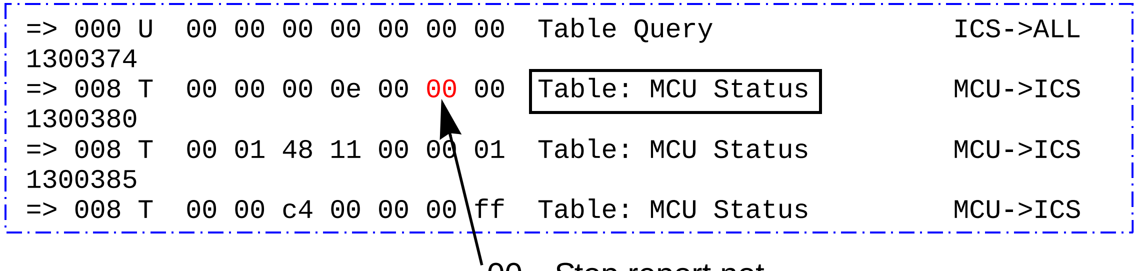
Use the following table to locate the defective controller.

Table 11-13: Controller Code Numbers for CANpro

NO.	CODE NUMBER	CONTROLLER NAME
1	00	MCU
4	10	GPC
5	20	RTC
6	30	PTH
7	40	PTV
8	50	XRS
9	60	DLPHI
10	A0	ZCO
11	CO	ACU

Analyzing the Results

The following is an example of results received when sending the telegram as in the request above.



```
=> 000 U  00 00 00 00 00 00 00  Table Query              ICS->ALL
1300374
=> 008 T  00 00 00 0e 00 00 00  Table: MCU Status        MCU->ICS
1300380
=> 008 T  00 01 48 11 00 00 01  Table: MCU Status        MCU->ICS
1300385
=> 008 T  00 00 c4 00 00 00 ff  Table: MCU Status        MCU->ICS
```

00—Stop report not
opened by MCU

If one of the controllers reports 01, replace the MCB on the selected item.

If all the controllers report 00, and the error message still appears, continue with the procedure in the following section.

Troubleshooting

The troubleshooting procedure is based on the principle of disconnecting the different components included in the Stop Report loop and connecting special connectors with jumpers between the appropriate contacts instead of those components. Using this hardware configuration, relevant scenarios are run to bring the system to the STANDBY state. During the troubleshooting process, we bypass the following seven components:

- Workstation—including O2 computer, Rack (CIB) (SDB), and CT-Box (Stop Button)
- Gantry Rotation—including XRS, DELPHI, ACU, and ZCO boards
- Couch—including PTV and PTH boards
- GPC—including GPC board, Indication and Button panels
- PDC—including D451 and SLIO boards
- Gantry Stop Buttons—Two STOP buttons on the Gantry
- Slice CounterSlice Counter

There are two possibilities for troubleshooting the problem.

- In case there is suspicion of a particular faulty component, attach the relevant connector to the MCU board and run the appropriate scenario (see *Table 11-14*).
- If there is no suspicion of any specific component, follow the entire procedure outlined in the *"Troubleshooting Step-By-Step—Flowchart"*. The flowchart is designed to allow the detection of the defective component in the minimum amount of steps.

Table 11-14 lists the components and the connector on the MCU board that bypasses the relevant component.

> **NOTE:**
>
> To run the diagnostic scenario from CANpro, disconnect the workstation and connect the A1 connector.

Table 11-14: Connectors and Scenarios

STEP NUMBER	COMPONENT	CONNECTOR OF MCU BOARD	SCENARIOS USED
A1	Workstation	X13	init_sb
A2	Gantry Rotation	X2	no_rot
A3	Couch	X16	no_couch
A4	GPC	X3	no_gpc
A5	PDC	X14	no_xrs
A7	Gantry Stop Buttons	X9	init_sb
A8	Slice counter	X21	init_sb
A6	XRS	Connector on Cable W560 (see *Figure 11-5*)	no_xrs

> **NOTE:**
>
> 1. If the component in question is the PDC (SLIO D451) you must also bypass the XRS.
> 2. If the component in question is the XRS you must only bypass the XRS.
>
> If after bypassing all of the above components the error still appears, replace the MCU_RTC board and the two MCBs (MCU, RTC)

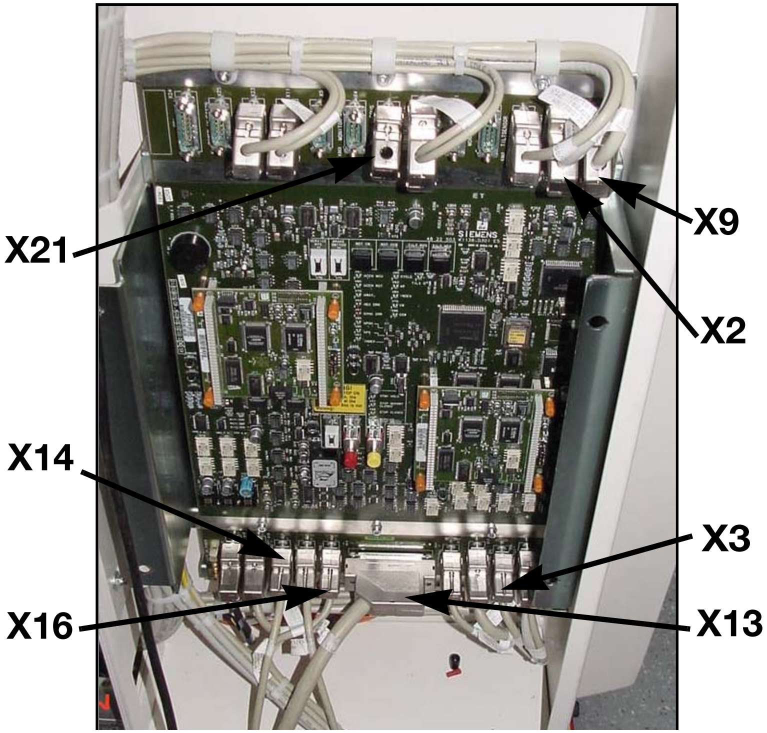


Figure 11-4: MCU Board

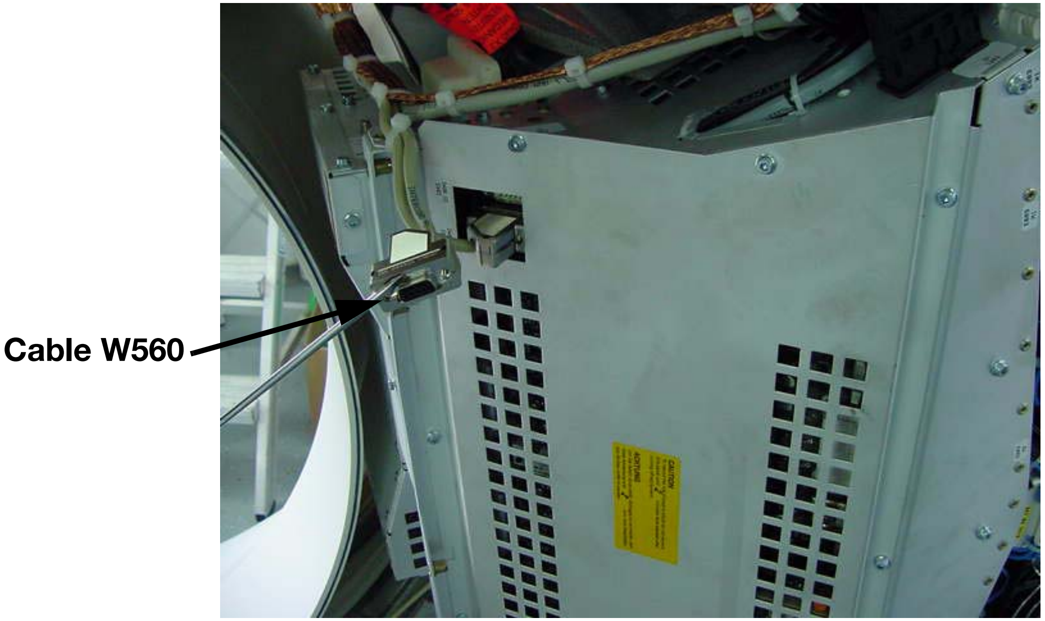


Figure 11-5: Cable W560

NOTE:

After replacing the MCB board, load the firmware. Make sure that the firmware version matches the software version on the host computer.

Cables and Pin Layout

The *"Troubleshooting Step-By-Step—Flowchart"* describes the bypass procedure for eliminating each device with its connecting cable in the MCU_RTC board as the cause of the error. To eliminate all factors, it is necessary to verify the proper functioning of the relevant cable during the procedure.

The following table contains all the cables for each connector (see *"Cable Pin Layout"* for cable pin descriptions).

Check the continuity of the cable in pins starting with a **Stoprep** prefix in the following cables:

Table 11-15:

DESCRIPTION	CABLE
Workstation	W50
Slip Ring + Rotor	W364
Couch	W52
GPC	W351
PDC	W51
Gantry Stop Buttons	W362
Slice Counter	W392
XRS	W560

Installing the Troubleshooting Scenarios From the Diskette

NOTE:

The following procedure is not necessary in CANpro version 7.5 (used in Mx8000 version 2.2).

Install the troubleshooting scenarios as follows:

1. Insert the scenario diskette to drive A.
2. Run the Windows Explorer.
3. In the **Mx8000\Scenario\Diag** directory create a folder called **stop_rep**.
4. Copy the contents of the diskette to the **stop_rep** folder.

Running the Scenarios

1. On the CANpro menu bar, click **Simulation|Load**.
2. Select the directory **Mx8000\Scenario\Diag\stop_rep** where you copied the scenario files to in the previous procedure.
3. Select the desired scenario and click **OK.** Press F4 to run the scenario.
4. Wait until the scenario begins to run. Click **OK** when prompted.
5. Click **OK** when the following message appears:

```
008 ID     00  00  00  00  00  00   Init Done     MCU--> ICS
```

6. Click **OK** immediately when prompted again.

NOTE:

Leave the bypass connectors on when proceeding through the flowchart.

Stop Circuit-Details

To activate K15, and thus to CLOSE the contact of the Stop Report Loop, all STOP-buttons (one in each Gantry Panel and one in the Scan Control), and the contact of the CIB-MCB, must be CLOSED.

Table 11-16: LED Description

LEDS	DESCRIPTION
STOPREPCLOSED	The STOPREPCLOSED LED is lit if the Stop Report Loop is CLOSED.
STOPCLOSED	The STOPCLOSED LED is ON if the Stop Circuit is CLOSED, i.e. all power contactors (Gantry Rotation/Tilt, table Feed/Lift, etc.) are activated.
STOPHOLD	The STOPHOLD LED is ON if the signal stophold is set from the MCU-MCB to provide the ground connection for the Stop Report Loop and the Stop Circuit.
24V	The 24V LED is an indication of the 24 V power supply.
SERVICESTOPON	The SERVICESTOPON LED is ON if the yellow push button "SERVICESTOPON" was pressed. In this case, the Stop Circuit can be CLOSED and all power contactors (Gantry Rotation/Tilt, Table Feed/Lift, etc.) activated, though the Stop Report Loop is OPENED, for any service activities.

Service Switches/Push Buttons

Table 11-17: Switch/Push Buttons Table

SWITCH/PUSH BUTTON	DESCRIPTION
SERVICESTOPOFF	Pressing the SERVICESTOPOFF push button interrupts the Stop Report Loop (K1, K2 drops) and the Stop Circuit. This creates the same reaction as in pressing a STOP button.
SERVICESTOPREPORT	If the SERVICESTOPREPORT switch is CLOSED, 24 V are permanently connected to the Stop Report Loop. This might be necessary for troubleshooting the Stop Report Loop is permanently interrupted anywhere. There is no normal operation of the scanner possible with this switch CLOSED.
SERVICESTOPON	If the SERVICESTOPON push button is pressed, the Stop Circuit can be CLOSED and all power contactors (Gantry Rotation/Tilt, Table Feed/Lift, etc.) activated, though the Stop Report Loop is OPENED, for any service activities.

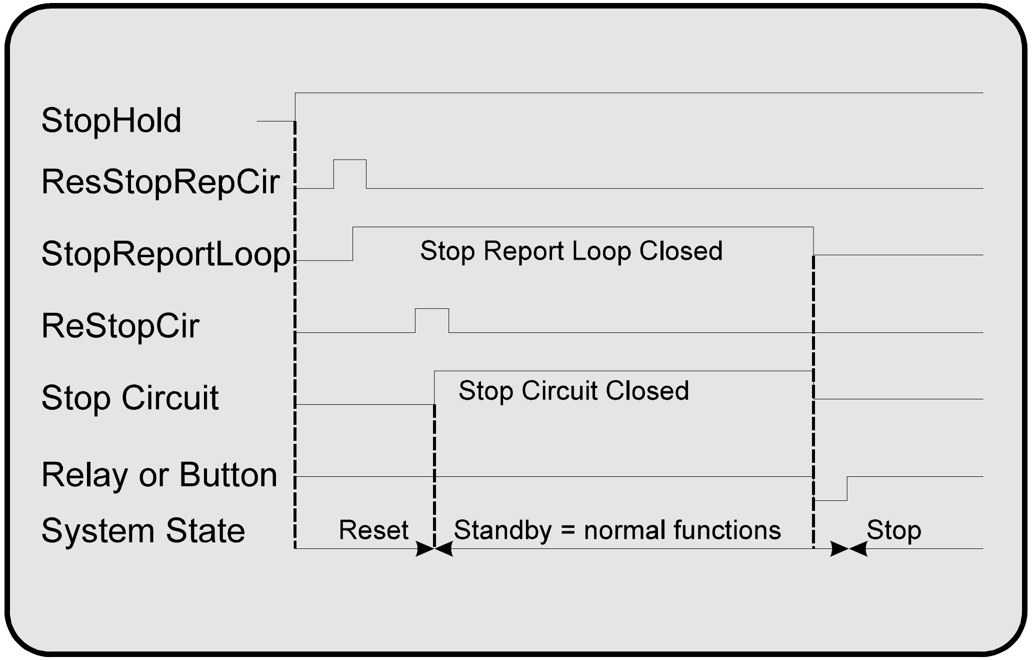

StopHold
ResStopRepCir
StopReportLoop
Stop Report Loop Closed
ReStopCir
Stop Circuit
Stop Circuit Closed
Relay or Button
System State
Reset
Standby = normal functions
Stop

Figure 11-6: Stop Circuit- Timing Diagram

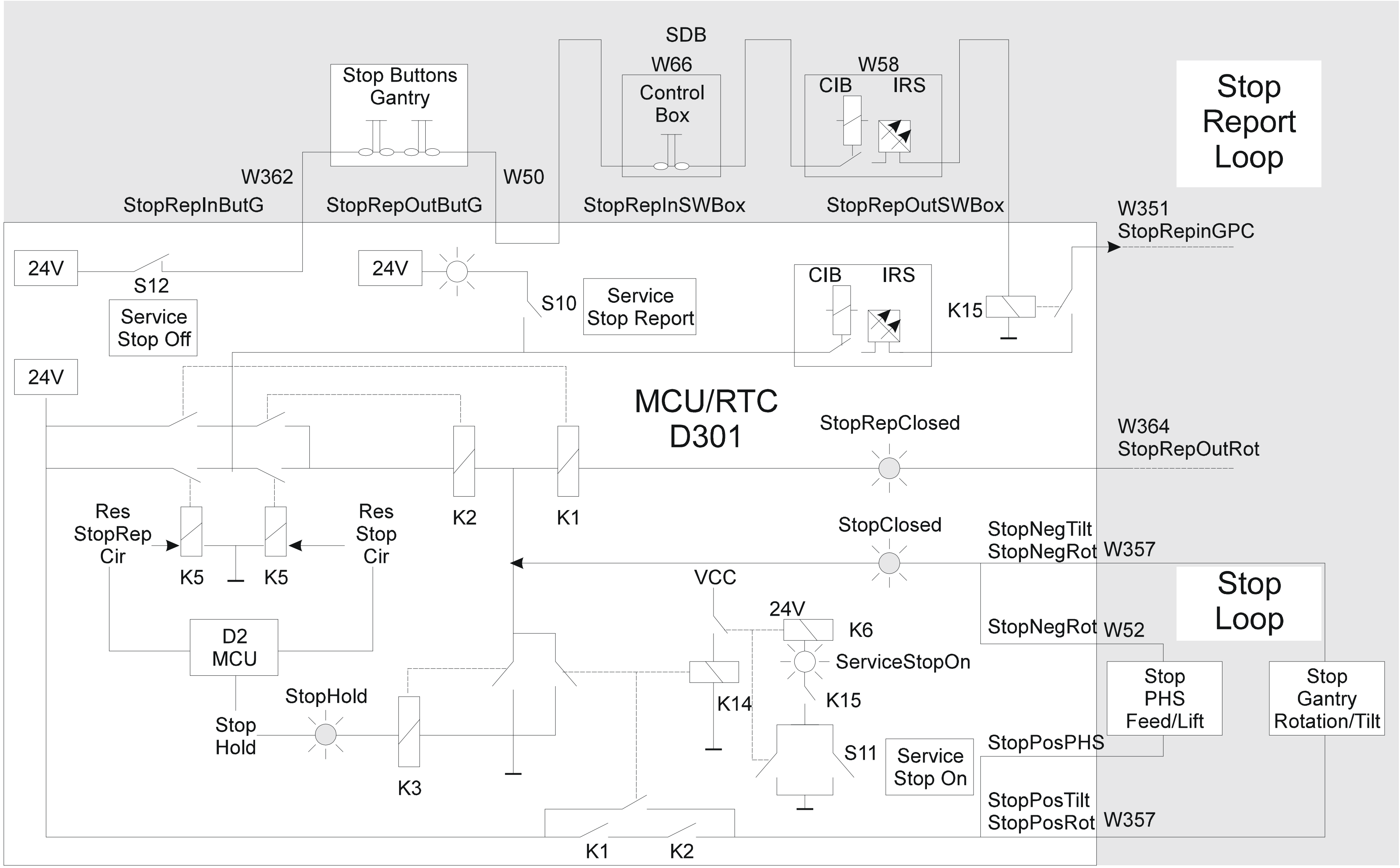
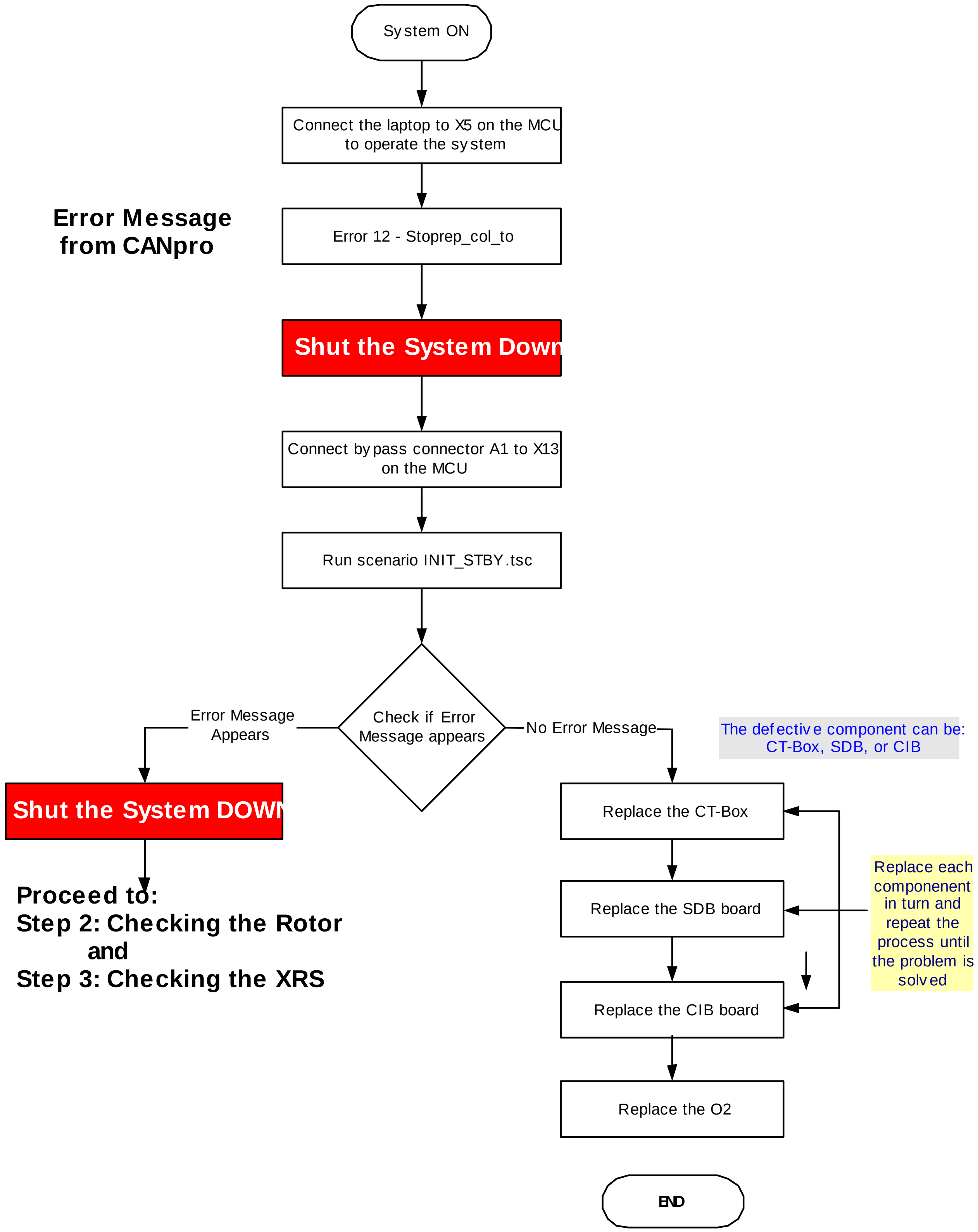

SDB
W66
Control Box
W58
CIB
IRS
Stop Buttons Gantry
Stop Report Loop
W362
W50
StopRepInButG
StopRepOutButG
StopRepInSWBox
StopRepOutSWBox
W351
StopRepinGPC
24V
S12
Service Stop Off
24V
S10
Service Stop Report
CIB
IRS
K15
24V
MCU/RTC
D301
StopRepClosed
W364
StopRepOutRot
K2
K1
Res StopRep Cir
K5
K5
Res Stop Cir
StopClosed
StopNegTilt
StopNegRot
W357
VCC
24V
K6
Stop Loop
StopNegRot
W52
D2 MCU
ServiceStopOn
K14
K15
Stop PHS Feed/Lift
Stop Gantry Rotation/Tilt
StopHold
Stop Hold
K3
S11
Service Stop On
StopPosPHS
StopPosTilt
StopPosRot
W357
K1
K2

Figure 11-7: Stop Circuit- Details

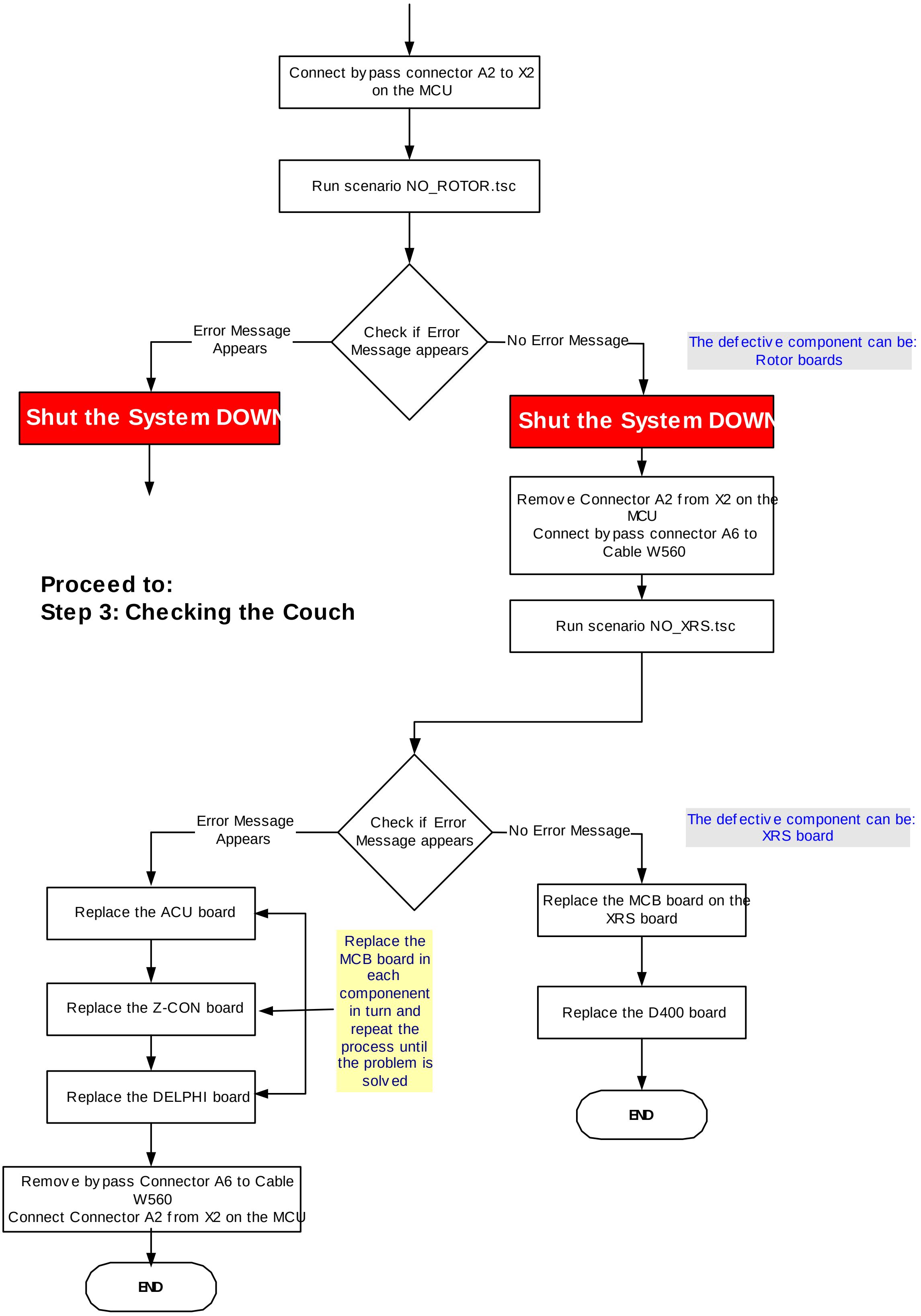
Troubleshooting Step-By-Step—Flowchart

Step 1: Checking the Workstation

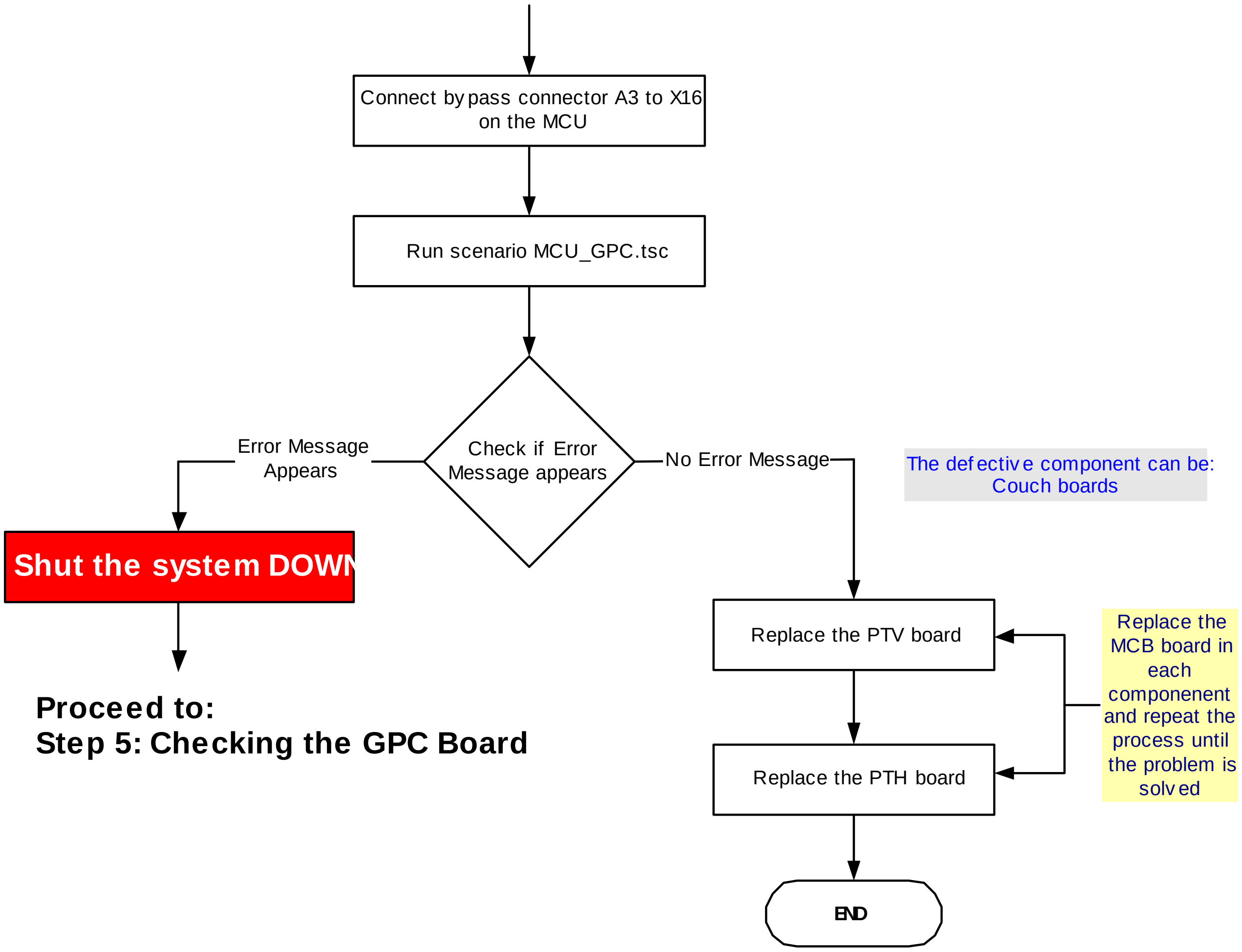

System ON
Connect the laptop to X5 on the MCU to operate the system
Error Message from CANpro
Error 12 - Stoprep_col_to
Shut the System Down
Connect bypass connector A1 to X13 on the MCU
Run scenario INIT_STBY.tsc
Check if Error Message appears
Error Message Appears
No Error Message
Shut the System DOW
Proceed to:
Step 2: Checking the Rotor
and
Step 3: Checking the XRS
The defective component can be: CT-Box, SDB, or CIB
Replace the CT-Box
Replace the SDB board
Replace the CIB board
Replace the O2
Replace each componenent in turn and repeat the process until the problem is solved
END

Step 2: Checking the Rotor

Step 3: Checking the XRS


Connect bypass connector A2 to X2 on the MCU
Run scenario NO_ROTOR.tsc
Check if Error Message appears
Error Message Appears
No Error Message
The defective component can be: Rotor boards
Shut the System DOWN
Shut the System DOWN
Remove Connector A2 from X2 on the MCU
Connect bypass connector A6 to Cable W560
Proceed to:
Step 3: Checking the Couch
Run scenario NO_XRS.tsc
Check if Error Message appears
Error Message Appears
No Error Message
The defective component can be: XRS board
Replace the ACU board
Replace the Z-CON board
Replace the DELPHI board
Replace the MCB board in each componenent in turn and repeat the process until the problem is solved
Replace the MCB board on the XRS board
Replace the D400 board
END
Remove bypass Connector A6 to Cable W560
Connect Connector A2 from X2 on the MCU
END

Step 4: Checking the Couch

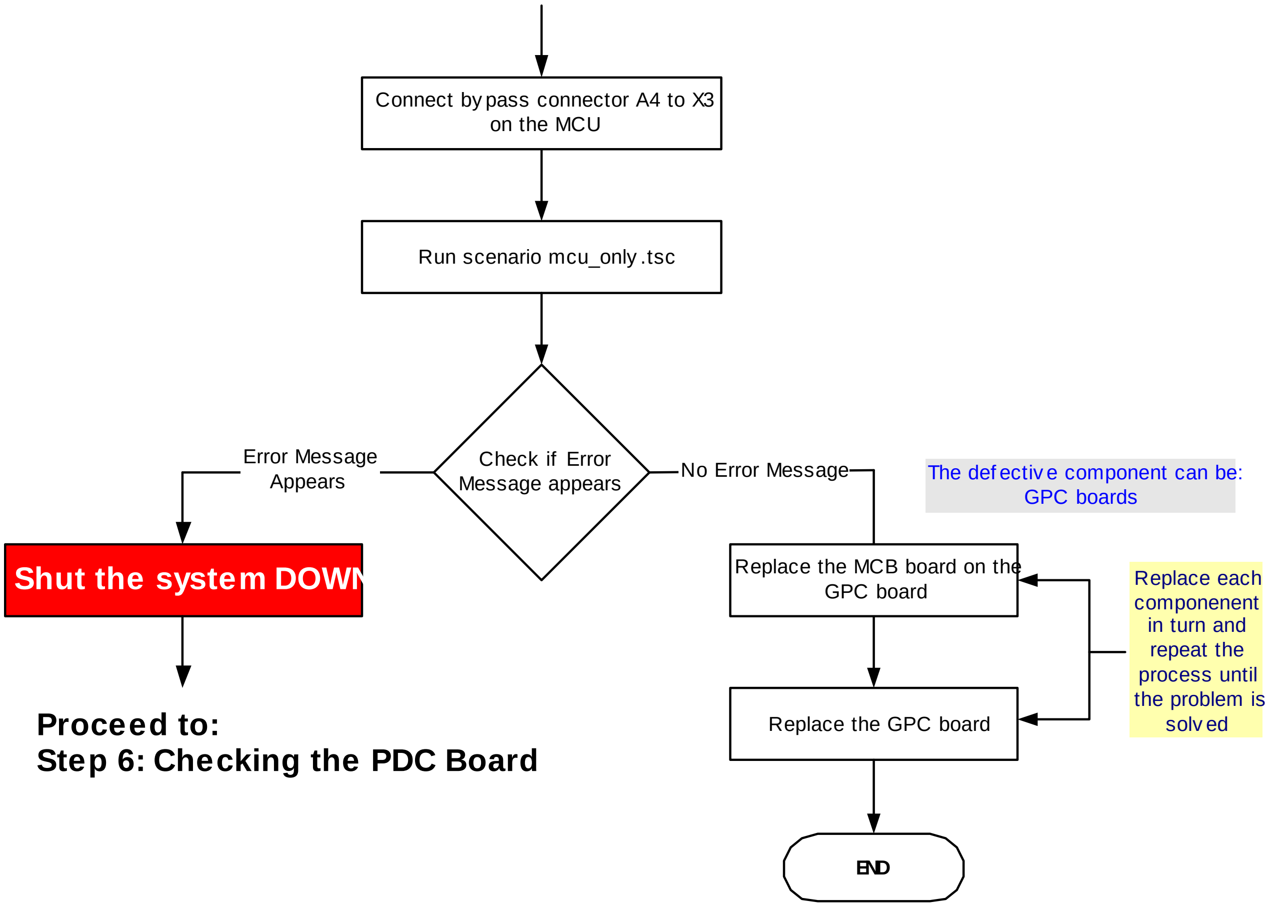

Connect bypass connector A3 to X16 on the MCU
Run scenario MCU_GPC.tsc
Check if Error Message appears
Error Message Appears
No Error Message
Shut the system DOWN
The defective component can be: Couch boards
Replace the PTV board
Replace the PTH board
Replace the MCB board in each componenent and repeat the process until the problem is solved
END

Proceed to:
Step 5: Checking the GPC Board

NOTE:

In case of replacement of either the PTV controller or PTH board, you must recalibrate PTV and PTH movement according to *"Patient Table Horizontal (PTH) Adjustment"* and *"Patient Table Vertical (PTV) Adjustment"*.

Step 5: Checking the GPC Board

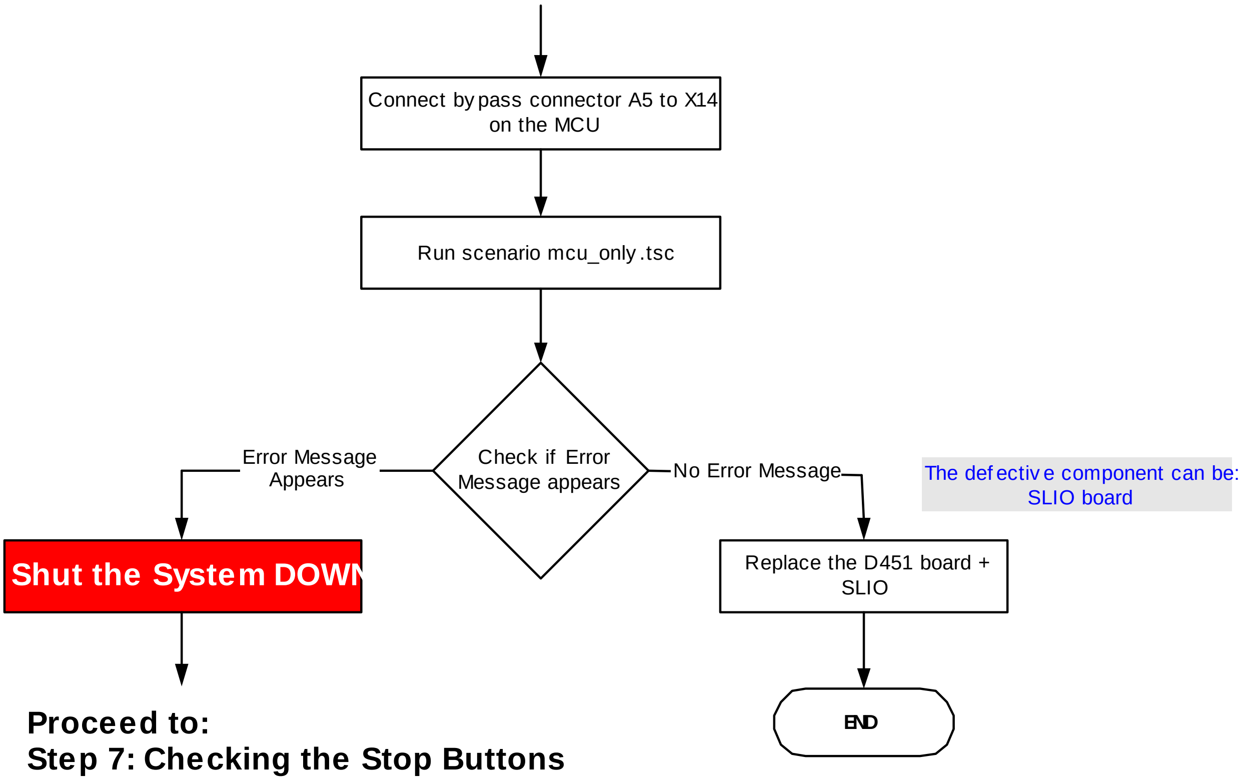

Connect bypass connector A4 to X3 on the MCU
Run scenario mcu_only.tsc
Check if Error Message appears
Error Message Appears
No Error Message
Shut the system DOWN
Proceed to:
Step 6: Checking the PDC Board
The defective component can be: GPC boards
Replace the MCB board on the GPC board
Replace the GPC board
Replace each componenent in turn and repeat the process until the problem is solved
END

NOTE:

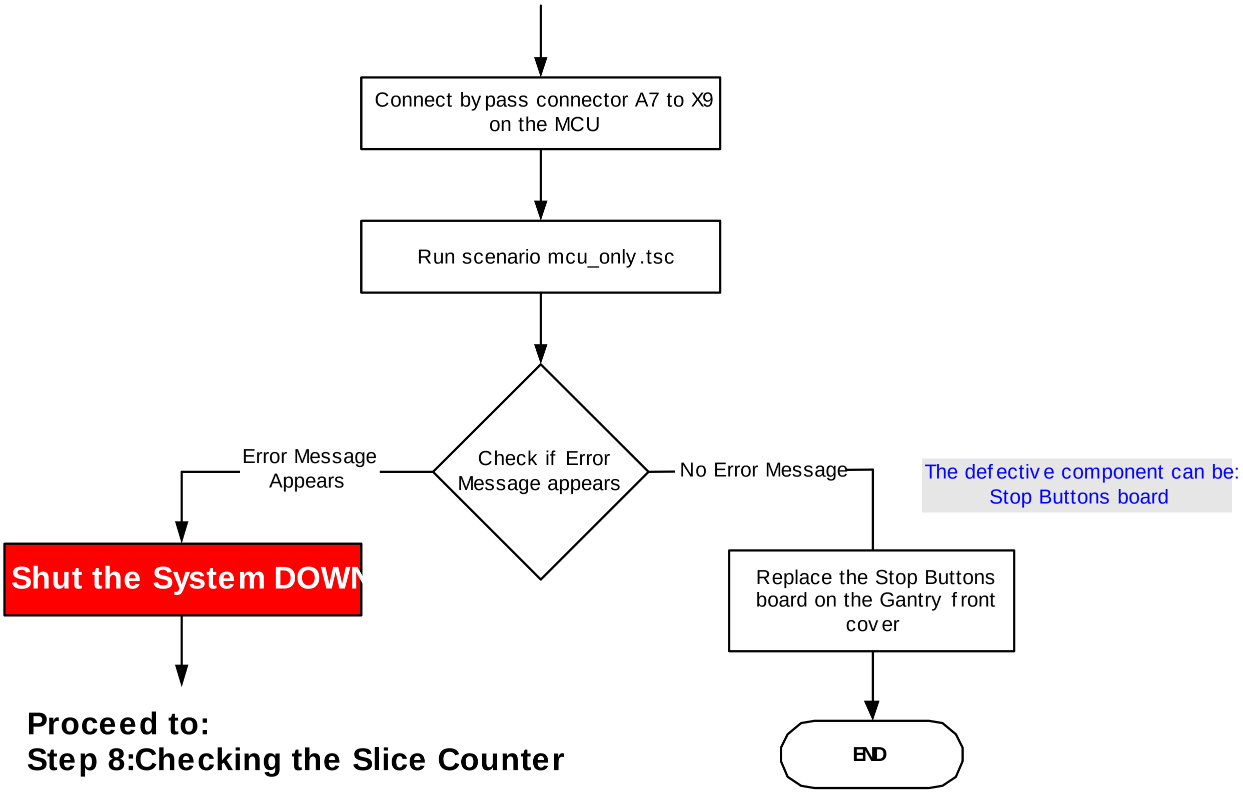
To verify that the system is in STANDBY Mode (STANDBY mode is not displayed on the CT-Box) do as follows:

- For CANpro v7.5 / 8—click **Monitor | Gantry Status**

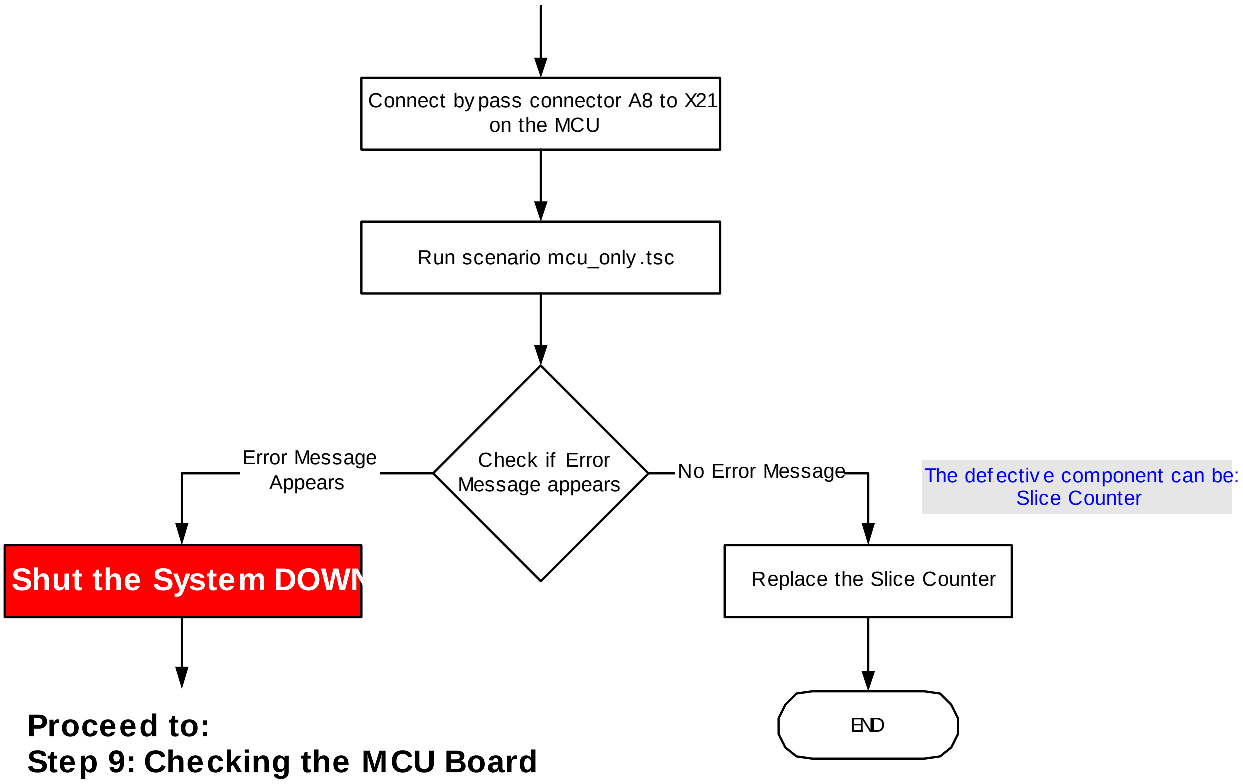
Step 6: Checking the PDC Board


Connect bypass connector A5 to X14 on the MCU
Run scenario mcu_only.tsc
Check if Error Message appears
Error Message Appears
No Error Message
The defective component can be: SLIO board
Shut the System DOWN
Replace the D451 board + SLIO
END
Proceed to:
Step 7: Checking the Stop Buttons

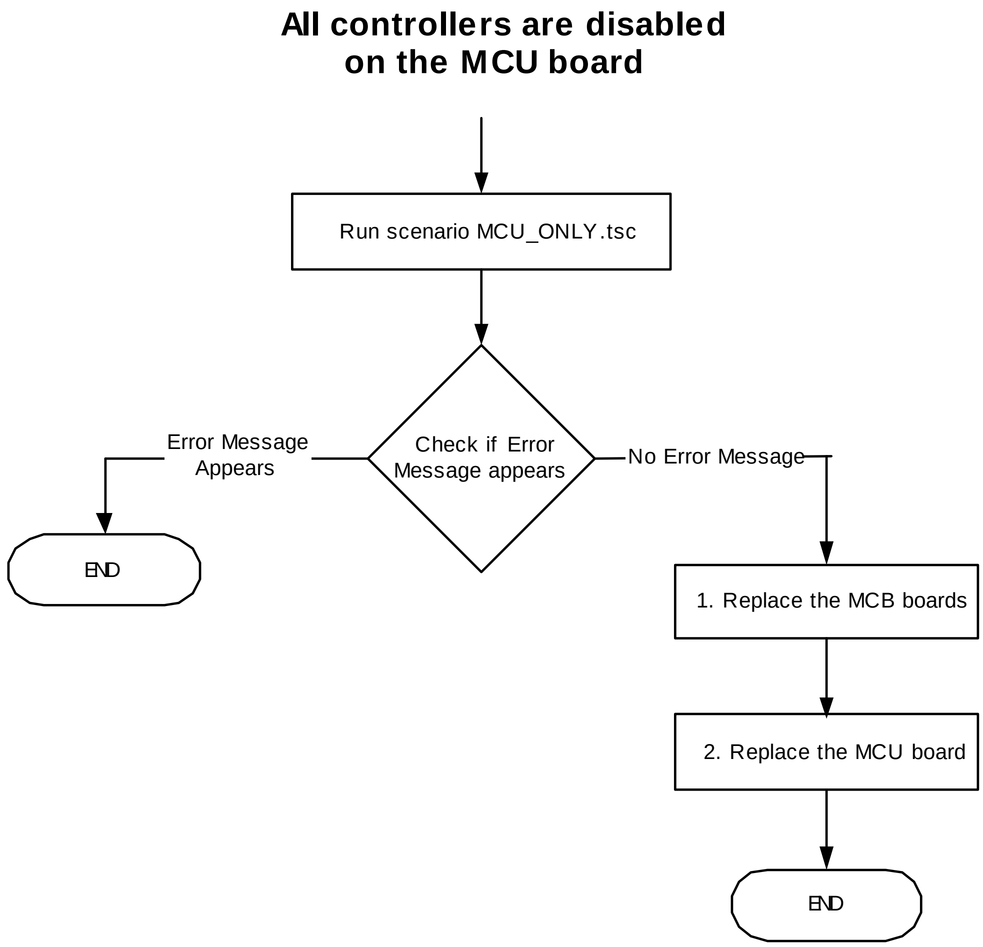
Step 7: Checking the Stop Buttons


Connect bypass connector A7 to X9 on the MCU
Run scenario mcu_only.tsc
Check if Error Message appears
Error Message Appears
No Error Message
The defective component can be: Stop Buttons board
Shut the System DOWN
Replace the Stop Buttons board on the Gantry front cover
END
Proceed to:
Step 8:Checking the Slice Counter

Step 8: Checking the Slice Counter


Connect bypass connector A8 to X21 on the MCU
Run scenario mcu_only.tsc
Check if Error Message appears
Error Message Appears
No Error Message
Shut the System DOWN
The defective component can be: Slice Counter
Replace the Slice Counter
END
Proceed to:
Step 9: Checking the MCU Board

Step 9: Checking the MCU Board


All controllers are disabled
on the MCU board
Run scenario MCU_ONLY.tsc
Check if Error
Message appears
Error Message
Appears
END
No Error Message
1. Replace the MCB boards
2. Replace the MCU board
END

Final Steps

At the end of the Troubleshooting procedure, do as follows:

- **Remove all the connectors from the MCU board and connect the original cables.**
- Connect the console to the system.
- Turn the system ON and check that it operates properly.

Stop Report Checklist

Use the checklist below to aid you in performing the troubleshooting procedure.

STEP	BYPASS COMPONENT	BYPASS CONNECTOR ON THE MCU BOARD	SCENARIO USED	
1	Workstation	X13	init_sb	☐
2	Rotor	X13 + X2	no_rotor	☐
3	XRS	X13 + W560	no_xrs	☐
4	Couch	X13 + X2 +X16	mcu_gpc	☐
5	GPC	X13 + X2 + X3 + X16	mcu_only	☐
6	PDC	X13 + X2 + X3 + X16 + X14	mcu_only	☐
7	Gantry Stop Buttons	X13 + X2 + X3 + X16 + X14 + X9	mcu_only	☐
8	Slice Counter	X13 + X2 + X3 + X16 + X14 + X9 + X21	mcu_only	☐

Recommended Spare Parts

Table 11-18 lists the spare parts recommended for Stop Report Troubleshooting.

Table 11-18: Spare Parts List

PHILIPS PART NUMBER	DESCRIPTION	ASSEMBLY
BR4718000561	CT-Box	Workstation
47371802506	SDB	Workstation
CP718022153	CIB board	IRS
SP714822503	MCU-RTC	Gantry Stator
47371804502	COUNTER	Gantry Stator
SP714796343	MCB	Gantry Stator
SP714795691	GPC	Gantry Stator
SP714822586	ACU board	Gantry Rotor
SP714822602	Z CON	Gantry Rotor
SP714822628	DELPHI	Gantry Rotor
SP713848608	XRS	Gantry Rotor
SP714795659	PTV board	Couch
SP714795675	PTH board	Couch
SP713848707	SLIO (D450)	PDC

Stop Report Cable Pin Layout

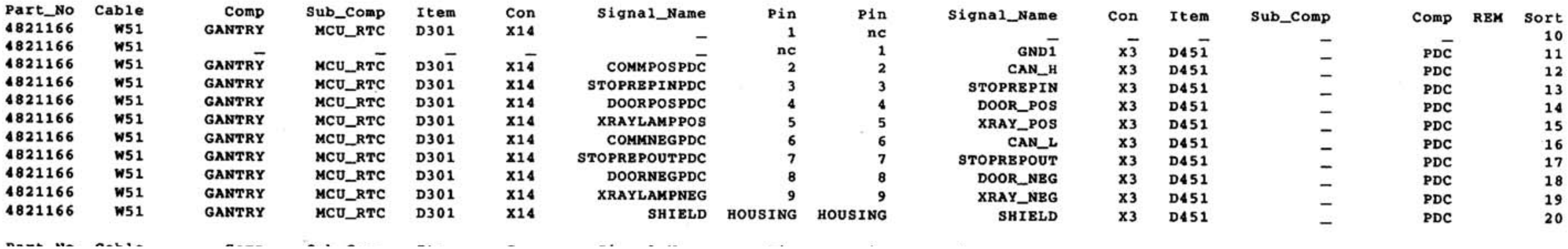
The following cables are listed in this section:

- W50
- W51
- W52
- W351
- W362
- W364

Cable W51

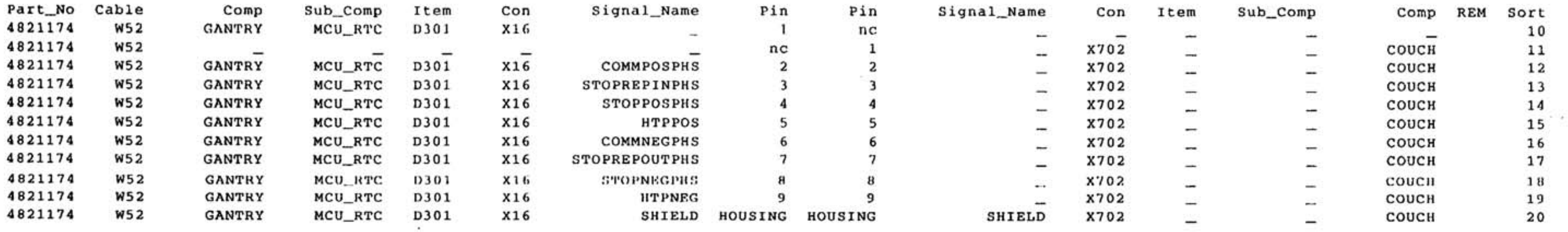
Part_No	Cable	Comp	Sub_Comp	Item	Con	Signal_Name	Pin	Pin	Signal_Name	Con	Item	Sub_Comp	Comp	REM	Sort
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	1	1	_	X1	_	_	SWITCHBOX		11
4821158	W50	GANTRY	MCU_RTC	D301	X13	COMMPOS	2	2	COMMPOSSWBOX	X1	_	_	SWITCHBOX		12
4821158	W50	GANTRY	MCU_RTC	D301	X13	STOPREPINSWBOX	3	3	_	X1	_	_	SWITCHBOX		13
4821158	W50	GANTRY	MCU_RTC	D301	X13	COM_OK_POS	4	4	_	X1	_	_	SWITCHBOX		14
4821158	W50	GANTRY	MCU_RTC	D301	X13	ACQ_OK_POS	5	5	_	X1	_	_	SWITCHBOX		15
4821158	W50	GANTRY	MCU_RTC	D301	X13	TRIGGER_IN1_POS	6	6	_	X1	_	_	SWITCHBOX		16
4821158	W50	GANTRY	MCU_RTC	D301	X13	TRIGGER_IN2_POS	7	7	_	X1	_	_	SWITCHBOX		17
4821158	W50	GANTRY	MCU_RTC	D301	X13	EN_ACQ_OK_POS	8	8	_	X1	_	_	SWITCHBOX		18
4821158	W50	GANTRY	MCU_RTC	D301	X13	XRAY_POS	9	9	_	X1	_	_	SWITCHBOX		19
4821158	W50	GANTRY	MCU_RTC	D301	X13	STARTKEYPOS	10	10	_	X1	_	_	SWITCHBOX		20
4821158	W50	GANTRY	MCU_RTC	D301	X13	MOVEKEYPOS	11	11	_	X1	_	_	SWITCHBOX		21
4821158	W50	GANTRY	MCU_RTC	D301	X13	HOLDMEASKEYPOS	12	12	_	X1	_	_	SWITCHBOX		22
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	13	13	_	X1	_	_	SWITCHBOX		23
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	14	14	_	X1	_	_	SWITCHBOX		24
4821158	W50	GANTRY	MCU_RTC	D301	X13	COMPULMORXD	15	15	_	X1	_	_	SWITCHBOX		25
4821158	W50	GANTRY	MCU_RTC	D301	X13	COMPWRINJECTORRXD	16	16	_	X1	_	_	SWITCHBOX		26
4821158	W50	GANTRY	MCU_RTC	D301	X13	NOICECANCELRXD	17	17	_	X1	_	_	SWITCHBOX		27
4821158	W50	GANTRY	MCU_RTC	D301	X13	COMMNEG	18	18	COMMNEGSWBOX	X1	_	_	SWITCHBOX		28
4821158	W50	GANTRY	MCU_RTC	D301	X13	STOPREPOUTSWBOX	19	19	_	X1	_	_	SWITCHBOX		29
4821158	W50	GANTRY	MCU_RTC	D301	X13	COM_OK_NEG	20	20	_	X1	_	_	SWITCHBOX		30
4821158	W50	GANTRY	MCU_RTC	D301	X13	ACQ_OK_NEG	21	21	_	X1	_	_	SWITCHBOX		31
4821158	W50	GANTRY	MCU_RTC	D301	X13	TRIGGER_IN1_NEG	22	22	_	X1	_	_	SWITCHBOX		32
4821158	W50	GANTRY	MCU_RTC	D301	X13	TRIGGER_IN2_NEG	23	23	_	X1	_	_	SWITCHBOX		33
4821158	W50	GANTRY	MCU_RTC	D301	X13	EN_ACQ_OK_NEG	24	24	_	X1	_	_	SWITCHBOX		34
4821158	W50	GANTRY	MCU_RTC	D301	X13	XRAY_NEG	25	25	_	X1	_	_	SWITCHBOX		35
4821158	W50	GANTRY	MCU_RTC	D301	X13	STARTKEYNEG	26	26	_	X1	_	_	SWITCHBOX		36
4821158	W50	GANTRY	MCU_RTC	D301	X13	MOVEKEYNEG	27	27	_	X1	_	_	SWITCHBOX		37
4821158	W50	GANTRY	MCU_RTC	D301	X13	HOLDMEASKEYNEG	28	28	_	X1	_	_	SWITCHBOX		38
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	29	29	_	X1	_	_	SWITCHBOX		39
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	30	30	_	X1	_	_	SWITCHBOX		40
4821158	W50	GANTRY	MCU_RTC	D301	X13	COMPULMOTXD	31	31	_	X1	_	_	SWITCHBOX		41
4821158	W50	GANTRY	MCU_RTC	D301	X13	COMPWRINJECTORTXD	32	32	_	X1	_	_	SWITCHBOX		42
4821158	W50	GANTRY	MCU_RTC	D301	X13	NOICECANCELTXD	33	33	_	X1	_	_	SWITCHBOX		43
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	34	34	COMMGNDSWBOX	X1	_	_	SWITCHBOX		44
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	35	35	_	X1	_	_	SWITCHBOX		45
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	36	36	_	X1	_	_	SWITCHBOX		46
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	37	37	_	X1	_	_	SWITCHBOX		47
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	38	38	_	X1	_	_	SWITCHBOX		48
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	39	39	_	X1	_	_	SWITCHBOX		49
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	40	40	_	X1	_	_	SWITCHBOX		50
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	41	41	_	X1	_	_	SWITCHBOX		51
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	42	42	_	X1	_	_	SWITCHBOX		52
4821158	W50	GANTRY	MCU_RTC	D301	X13	AUDIOLS	43	43	_	X1	_	_	SWITCHBOX		53
4821158	W50	GANTRY	MCU_RTC	D301	X13	AUDIOLSGND	44	44	_	X1	_	_	SWITCHBOX		54
4821158	W50	GANTRY	MCU_RTC	D301	X13	AUDIOMIC	45	45	_	X1	_	_	SWITCHBOX		55
4821158	W50	GANTRY	MCU_RTC	D301	X13	AUDIOMICGND	46	46	_	X1	_	_	SWITCHBOX		56
4821158	W50	GANTRY	MCU_RTC	D301	X13	COMPULMOGND	47	47	_	X1	_	_	SWITCHBOX		57
4821158	W50	GANTRY	MCU_RTC	D301	X13	COMPWRINJECTORGND	48	48	_	X1	_	_	SWITCHBOX		58
4821158	W50	GANTRY	MCU_RTC	D301	X13	NOICECANCELGND	49	49	_	X1	_	_	SWITCHBOX		59
4821158	W50	GANTRY	MCU_RTC	D301	X13	_	50	50	_	X1	_	_	SWITCHBOX		60
4821158	W50	GANTRY	MCU_RTC	D301	X13	SHIELD	HOUSING	HOUSING	SHIELD	X1	_	_	SWITCHBOX		61

Cable W51



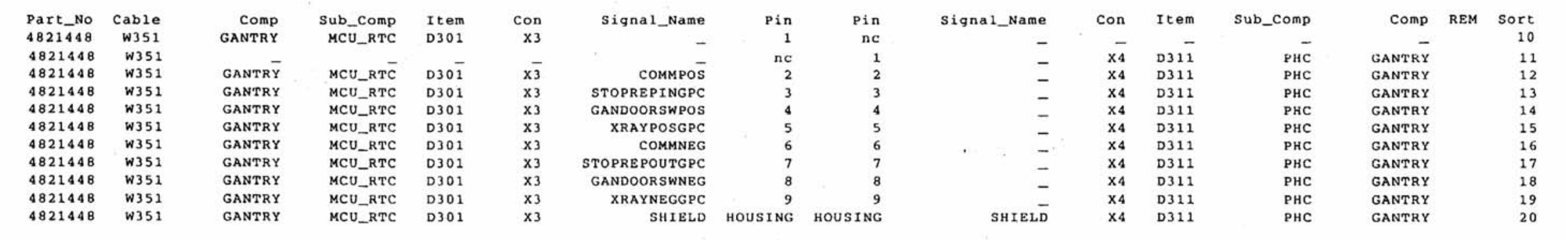
Part_No	Cable	Comp	Sub_Comp	Item	Con	Signal_Name	Pin	Pin	Signal_Name	Con	Item	Sub_Comp	Comp	REM	Sort
4821166	W51	GANTRY	MCU_RTC	D301	X14	_	1	nc	_	_	_	_	_		10
4821166	W51	_	_	_	_	_	nc	1	GND1	X3	D451	_	PDC		11
4821166	W51	GANTRY	MCU_RTC	D301	X14	COMMPOSPDC	2	2	CAN_H	X3	D451	_	PDC		12
4821166	W51	GANTRY	MCU_RTC	D301	X14	STOPREPINPDC	3	3	STOPREPIN	X3	D451	_	PDC		13
4821166	W51	GANTRY	MCU_RTC	D301	X14	DOORPOSPDC	4	4	DOOR_POS	X3	D451	_	PDC		14
4821166	W51	GANTRY	MCU_RTC	D301	X14	XRAYLAMPPOS	5	5	XRAY_POS	X3	D451	_	PDC		15
4821166	W51	GANTRY	MCU_RTC	D301	X14	COMMNEGPDC	6	6	CAN_L	X3	D451	_	PDC		16
4821166	W51	GANTRY	MCU_RTC	D301	X14	STOPREPOUTPDC	7	7	STOPREPOUT	X3	D451	_	PDC		17
4821166	W51	GANTRY	MCU_RTC	D301	X14	DOORNEGPDC	8	8	DOOR_NEG	X3	D451	_	PDC		18
4821166	W51	GANTRY	MCU_RTC	D301	X14	XRAYLAMPNEG	9	9	XRAY_NEG	X3	D451	_	PDC		19
4821166	W51	GANTRY	MCU_RTC	D301	X14	SHIELD	HOUSING	HOUSING	SHIELD	X3	D451	_	PDC		20

Cable W52



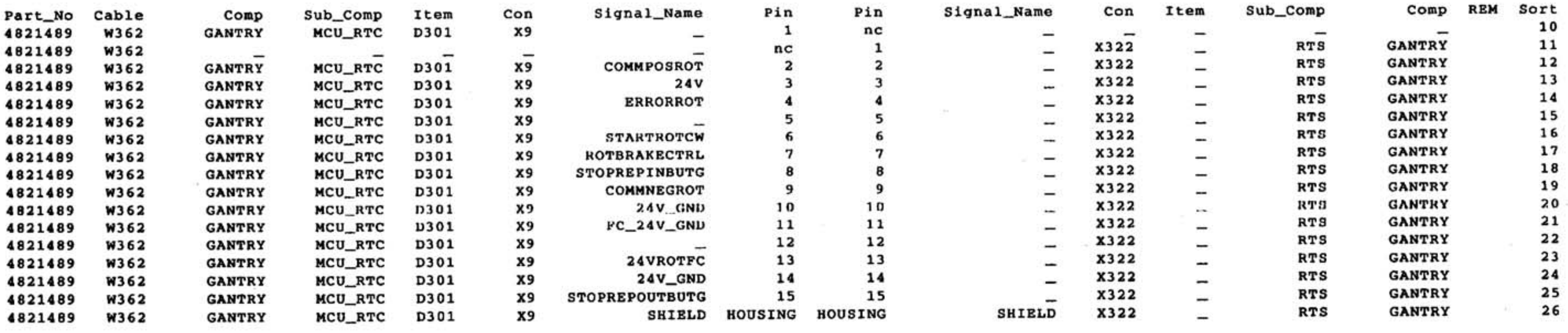
Part_No	Cable	Comp	Sub_Comp	Item	Con	Signal_Name	Pin	Pin	Signal_Name	Con	Item	Sub_Comp	Comp	REM	Sort
4821174	W52	GANTRY	MCU_RTC	D301	X16	_	1	nc	_	_	_	_	_		10
4821174	W52	_	_	_	_	_	nc	1	_	X702	_	_	COUCH		11
4821174	W52	GANTRY	MCU_RTC	D301	X16	COMMPOSPHS	2	2	_	X702	_	_	COUCH		12
4821174	W52	GANTRY	MCU_RTC	D301	X16	STOPREPINPHS	3	3	_	X702	_	_	COUCH		13
4821174	W52	GANTRY	MCU_RTC	D301	X16	STOPPOSPHS	4	4	_	X702	_	_	COUCH		14
4821174	W52	GANTRY	MCU_RTC	D301	X16	HTPPOS	5	5	_	X702	_	_	COUCH		15
4821174	W52	GANTRY	MCU_RTC	D301	X16	COMMNEGPHS	6	6	_	X702	_	_	COUCH		16
4821174	W52	GANTRY	MCU_RTC	D301	X16	STOPREPOUTPHS	7	7	_	X702	_	_	COUCH		17
4821174	W52	GANTRY	MCU_RTC	D301	X16	STOPNEGPHS	8	8	_	X702	_	_	COUCH		18
4821174	W52	GANTRY	MCU_RTC	D301	X16	HTPNEG	9	9	_	X702	_	_	COUCH		19
4821174	W52	GANTRY	MCU_RTC	D301	X16	SHIELD	HOUSING	HOUSING	SHIELD	X702	_	_	COUCH		20

Cable W351



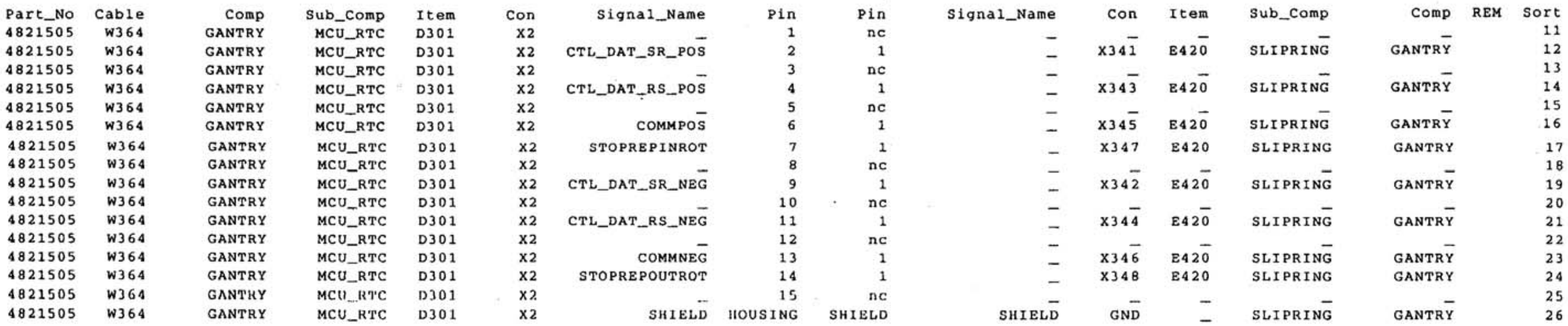
Part_No	Cable	Comp	Sub_Comp	Item	Con	Signal_Name	Pin	Pin	Signal_Name	Con	Item	Sub_Comp	Comp	REM	Sort
4821448	W351	GANTRY	MCU_RTC	D301	X3	_	1	nc	_	_	_	_	_		10
4821448	W351	_	_	_	_	_	nc	1	_	X4	D311	PHC	GANTRY		11
4821448	W351	GANTRY	MCU_RTC	D301	X3	COMMPOS	2	2	_	X4	D311	PHC	GANTRY		12
4821448	W351	GANTRY	MCU_RTC	D301	X3	STOPREPINGPC	3	3	_	X4	D311	PHC	GANTRY		13
4821448	W351	GANTRY	MCU_RTC	D301	X3	GANDOORSWPOS	4	4	_	X4	D311	PHC	GANTRY		14
4821448	W351	GANTRY	MCU_RTC	D301	X3	XRAYPOSGPC	5	5	_	X4	D311	PHC	GANTRY		15
4821448	W351	GANTRY	MCU_RTC	D301	X3	COMMNEG	6	6	_	X4	D311	PHC	GANTRY		16
4821448	W351	GANTRY	MCU_RTC	D301	X3	STOPREPOUTGPC	7	7	_	X4	D311	PHC	GANTRY		17
4821448	W351	GANTRY	MCU_RTC	D301	X3	GANDOORSWNEG	8	8	_	X4	D311	PHC	GANTRY		18
4821448	W351	GANTRY	MCU_RTC	D301	X3	XRAYNEGGPC	9	9	_	X4	D311	PHC	GANTRY		19
4821448	W351	GANTRY	MCU_RTC	D301	X3	SHIELD	HOUSING	HOUSING	SHIELD	X4	D311	PHC	GANTRY		20

Cable W362



Part_No	Cable	Comp	Sub_Comp	Item	Con	Signal_Name	Pin	Pin	Signal_Name	Con	Item	Sub_Comp	Comp	REM	Sort
4821489	W362	GANTRY	MCU_RTC	D301	X9	_	1	nc	_	_	_	_	_		10
4821489	W362	_	_	_	_	_	nc	1	_	X322	_	RTS	GANTRY		11
4821489	W362	GANTRY	MCU_RTC	D301	X9	COMMPOSROT	2	2	_	X322	_	RTS	GANTRY		12
4821489	W362	GANTRY	MCU_RTC	D301	X9	24V	3	3	_	X322	_	RTS	GANTRY		13
4821489	W362	GANTRY	MCU_RTC	D301	X9	ERRORROT	4	4	_	X322	_	RTS	GANTRY		14
4821489	W362	GANTRY	MCU_RTC	D301	X9	_	5	5	_	X322	_	RTS	GANTRY		15
4821489	W362	GANTRY	MCU_RTC	D301	X9	STARTROTCW	6	6	_	X322	_	RTS	GANTRY		16
4821489	W362	GANTRY	MCU_RTC	D301	X9	ROTBRAKECTRL	7	7	_	X322	_	RTS	GANTRY		17
4821489	W362	GANTRY	MCU_RTC	D301	X9	STOPREPINBUTG	8	8	_	X322	_	RTS	GANTRY		18
4821489	W362	GANTRY	MCU_RTC	D301	X9	COMMNEGROT	9	9	_	X322	_	RTS	GANTRY		19
4821489	W362	GANTRY	MCU_RTC	D301	X9	24V_GND	10	10	_	X322	_	RTS	GANTRY		20
4821489	W362	GANTRY	MCU_RTC	D301	X9	FC_24V_GND	11	11	_	X322	_	RTS	GANTRY		21
4821489	W362	GANTRY	MCU_RTC	D301	X9	_	12	12	_	X322	_	RTS	GANTRY		22
4821489	W362	GANTRY	MCU_RTC	D301	X9	24VROTFC	13	13	_	X322	_	RTS	GANTRY		23
4821489	W362	GANTRY	MCU_RTC	D301	X9	24V_GND	14	14	_	X322	_	RTS	GANTRY		24
4821489	W362	GANTRY	MCU_RTC	D301	X9	STOPREPOUTBUTG	15	15	_	X322	_	RTS	GANTRY		25
4821489	W362	GANTRY	MCU_RTC	D301	X9	SHIELD	HOUSING	HOUSING	SHIELD	X322	_	RTS	GANTRY		26

Cable W364



Part_No	Cable	Comp	Sub_Comp	Item	Con	Signal_Name	Pin	Pin	Signal_Name	Con	Item	Sub_Comp	Comp	REM	Sort
4821505	W364	GANTRY	MCU_RTC	D301	X2	_	1	nc	_	_	_	_	_		11
4821505	W364	GANTRY	MCU_RTC	D301	X2	CTL_DAT_SR_POS	2	1	_	X341	E420	SLIPRING	GANTRY		12
4821505	W364	GANTRY	MCU_RTC	D301	X2	_	3	nc	_	_	_	_	_		13
4821505	W364	GANTRY	MCU_RTC	D301	X2	CTL_DAT_RS_POS	4	1	_	X343	E420	SLIPRING	GANTRY		14
4821505	W364	GANTRY	MCU_RTC	D301	X2	_	5	nc	_	_	_	_	_		15
4821505	W364	GANTRY	MCU_RTC	D301	X2	COMMPOS	6	1	_	X345	E420	SLIPRING	GANTRY		16
4821505	W364	GANTRY	MCU_RTC	D301	X2	STOPREPINROT	7	1	_	X347	E420	SLIPRING	GANTRY		17
4821505	W364	GANTRY	MCU_RTC	D301	X2	_	8	nc	_	_	_	_	_		18
4821505	W364	GANTRY	MCU_RTC	D301	X2	CTL_DAT_SR_NEG	9	1	_	X342	E420	SLIPRING	GANTRY		19
4821505	W364	GANTRY	MCU_RTC	D301	X2	_	10	nc	_	_	_	_	_		20
4821505	W364	GANTRY	MCU_RTC	D301	X2	CTL_DAT_RS_NEG	11	1	_	X344	E420	SLIPRING	GANTRY		21
4821505	W364	GANTRY	MCU_RTC	D301	X2	_	12	nc	_	_	_	_	_		22
4821505	W364	GANTRY	MCU_RTC	D301	X2	COMMNEG	13	1	_	X346	E420	SLIPRING	GANTRY		23
4821505	W364	GANTRY	MCU_RTC	D301	X2	STOPREPOUTROT	14	1	_	X348	E420	SLIPRING	GANTRY		24
4821505	W364	GANTRY	MCU_RTC	D301	X2	_	15	nc	_	_	_	_	_		25
4821505	W364	GANTRY	MCU_RTC	D301	X2	SHIELD	HOUSING	SHIELD	SHIELD	GND	_	SLIPRING	GANTRY		26

Chapter 12
Service Tools

Service and Calibration Tools 12-1

Service Tools and Calibrations 12-1
Service Menu Organization 12-1
General Information About Physics Calibrations 12-1
Z-Alignment Calibration 12-2
Z-Alignment Control Function 12-2
Z-Alignment Calibration Menus 12-2
Z-Alignment Calibration Procedure 12-5
Slice Normalization 12-5
Air Calibration 12-5
XRT – DFS Calibration 12-6
DFS Calibration Application 12-6
XRT - Filament Calibration 12-8
XRT - Current Calibration 12-9
UHR (Ultra-High Resolution) 12-10
Phantom Calibration 12-11
Temperature Display 12-12
Tube History Display 12-13
The Error Log Analyzing Tools 12-14
Using LogViewer 12-14
Using LogOnline 12-16
Using the Error Log 12-16

Communication (Data Path) Troubleshooting 12-18

Introduction 12-18
Data Path Field Replaceable Units (FRUs) 12-19
ACQ_OK 12-20
Data Path Block Diagram 12-21
ACQ Card Communication LEDs 12-22
General Tips 12-25
Error MCU 00 00 54 12-27
Bypass Procedure 12-29
Capacitor Ring Test Procedure 12-31
General 12-31
Preparations 12-31
Electrical Test 12-34
Visual Capacitor Ring Inspection 12-35
Replacing the Funnel 12-36
Avoiding ESD Damage to Gantry Receivers and Transmitters 12-37
Overview 12-37
Receiver / Transmitter Kit 12-38
Procedure 12-39

Service and Calibration Tools

Service Tools and Calibrations

This appendix describes some applications that are activated from the **SERVICE** menu. This menu is available from most applications and viewers of the Mx8000 Software.

The programs described in this appendix are used for the following purposes:

- Physical calibrations
- Troubleshooting and Diagnostics of Image Quality problems

Service Menu Organization

The service menu consists of three groups:

- Service Calibration in descending order for calibrations performed after XRT replacement
- Physics Diagnostic programs
- Other service programs

(XRT related programs include **XRT** in their name, for example: **XRT-DFS Alignment, XRT-Filament**.

General Information About Physics Calibrations

- All Physics Calibrations are invariant to the flags set-up defined in Service Parameters, e.g. Slice Normalization, Phantom Calibration, etc. This means that there is no need to change switches before or after calibration.
- All Physics Calibrations/Alignments, except XRT-DFS Alignment, perform their own Air Calibration if necessary, so there is no need to perform Air Calibration prior to the calibration.
- XRT-DFS Alignment uses slice thickness 4×5, and needs Air Calibration with this slice thickness prior to its activation. All Air Calibration should be repeated after the XRT-DFS Alignment.
- Air Calibrations for Ultra-high resolution mode should be repeated if the Ultra-high collimator (UHR) was moved during UHR alignment.

- Refer to specific instructions as to which calibrations to perform after new version upgrade. The order of calibration/alignment execution is important.

Z-Alignment Calibration

This program is activated to perform Z-alignment in the following cases:

- The XRT is replaced
- The Tube Collimator is replaced
- The P-Plane collimator encoder is readjusted
- The DMS is replaced.

Z-Alignment Control Function

Z-Alignment Control Function can be switched **ON** or **OFF** in **Service Parameters/Scan Parameters** menu by defining the **Z-Control (Z-tracking) function** as “Yes” or “No”.

Z-Alignment Calibration Menus

Calibrate (The Z-Alignment Calibration Program)

The program consists of a short automatic procedure.

The procedure aligns the Tube Collimator with the XRT focal spot (median detector line) and calibrates a special sensor (PSD) located inside the Tube Collimator. This sensor continuously tracks the focal spot position movement during routine scanning and adjusts the Tube Collimator accordingly.

The Z-Alignment Calibration program is set at a rotation time of 0.75sec and consists of the following steps:

1. XRT warm-up
2. Special Air Calibration (no Air Calibration is needed prior to this program)
3. Scans with different tube collimator positions, starting from -1.4 mm in 0.1 mm steps, until it passes the minimum PREP difference position

4. Performs a Control Scan at precisely calculated Tube Collimator position to verify the final optimal position
5. Updates the **MCU TAB** table with the optimal tube collimator position and PSD sensor reading if the alignment terminates successfully.

The **TAB** table that contains information about tube collimator location, is modified during the Z-Alignment **Calibrate** procedure, and is intended to provide correct Z-alignment for all rotation times.

The RAW data difference of external slices at 4×1 mm should normally be within ±5%.

NOTE:

If the PSD sensor is not working (hardware failure), the Tube Collimator alignment is still valid, but the **Z-control** flag in Service parameters must be switched off. If the Sensor reading is out of predefined limits, an appropriate message is displayed during the calibration.

Hardware Z-Check

This program is used to certify the accuracy of Z-alignment and correct functioning of hardware, such as PSD monitor (located in the Tube Collimator).

- The program warms up the tube before the first scan if it is completely cold.
  If the program starts when the tube is too hot, a message “Wait for the tube to cool” appears.
- The program performs three scans with the tube warming up between the second and the third scans.
  If the PSD monitor is not functioning properly, an appropriate message is issued.

Check Z-position

The program allows you to quickly verify the accuracy of the Z-position alignment and proper functioning of the hardware, for example: Z-position sensor functioning at any time.
The program performs 2 scans to verify the Z-alignment accuracy. It takes about 2 minutes.

Calibrate Results

The table contains the results of previously performed Z-alignment calibrations. It is updated online and can remain open at all times during the calibration.
If the **Calibrate Result** button is pressed during calibration, the user can watch the intermediate calibration result.

The table shows the PREP difference of three groups of detectors: left, center and right. The ideal position is when this value is zero. The program calculates and shows the optimal Tube Collimator position after the minimum point was passed.

If the data shows a large discrepancy between the left and right group of detectors, an appropriate message is displayed for the user.

Z-Alignment Calibration Procedure

The Z-Alignment Calibration procedure consists of the following two steps:

1. Z-Alignment Calibration procedure:
   During this step, the Tube Collimator optimal Z-position is found. To perform this step, activate the **XRT Z-Alignment|Calibrate** program.
2. Z-Alignment| Check Procedure:
   During this step, the accuracy of the Z-position alignment and proper Z-position sensor functioning is verified. To perform this step, activate the **XRT Z-Alignment|Z-Check** program.

Slice Normalization

The Slice Normalization is a software algorithm whose purpose is to correct for possible discrepancies in CT number (CT number stability) between the different slices, which can be caused by many different small mechanical imperfections.

The correction is based upon normalization to data acquired by extreme (first and last) detector modules of the DMS. These detectors, unlike the Reference detector, are very sensitive to the slightest beam movements and the algorithm automatically compensates for these changes.

The Slice Normalization function can be switched Off/On in **Service Parameters | Recon. Parameters.**

Air Calibration

The Air calibration procedure is improved for better ring artifact correction, especially for High and Ultra-High Resolution. One of the main steps consists of adapted mAs values for the different calibration modes.

- Air Calibrations for a rotation time of 1.5 second is added to improve the Slice Normalization performance.
- Surview Air Calibration for scanners without 0.5 sec rotation option is solved by using Air Calibrations for Surview scan from 4×1 mm slice thickness (or 2×1 for Dual scanner), 0.75 sec rotation time for scanners without this option.

XRT – DFS Calibration

The XRT-DFS calibration procedure is significantly improved for better spatial resolution precision for all rotation times. It includes:

- Full calibration for all rotation speeds (takes about 30 minutes!)
- Utilizes the channels defined in the “Bad Detector” file.

This application allows the performance of the following procedures, related to DFS calibration.

- “Calibrate”—DFS X-Axis Calibration: Fast, and All Rotation Times.
- “UHR”—Ultra High Resolution Collimator X-Axis Calibration.
- “Diagnostic”—DFS X-Axis scans in different modes for diagnostic purposes.
- “Axis on Prep”—Axis Calculation, using Prep information from the previously performed scan.
- “Show Results”—Shows table, containing the results obtained during “Calibrate” program execution.
- “Parameters”—Indicates of the parameters used for DFS axis calculations.

DFS Calibration Application

This application opens a window, allowing DFS calibration in two modes. These modes are described below.

Fast Automatic (Two Specific Modes DFS Calibration)

This program performs DFS calibrations for the following two modes:

- Standard Res. (large FS), 120 kV, RT 0.75 sec in DFS mode.
- Standard Res. (large FS), 120 kV, RT 0.5 sec in SFS (Single Focal Spot) mode.

Only the above-mentioned two DFS modes are calibrated precisely by this program. All other DFS modes are automatically updated by extrapolation.
The performed extrapolation is not 100% precise, but close enough, and allows for other scanner tests.
Use this calibration as the first step when the new XRT is installed and has to be calibrated for the first time. This considerably decreases the amount of time needed for Detailed DFS Calibration.

⚠ CAUTION

DO NOT PERFORM FAST CALIBRATION AFTER **DETAILED DFS CALIBRATION** (SEE NEXT STEP) SINCE THE PRECISE PARAMETER VALUES ARE REPLACED BY THE EXTRAPOLATED ONES.

Calibrate all Rot Times (Detailed DFS Calibration)

This calibration must be performed after or instead of the “Fast Automatic” calibration. It takes about 40 minutes.

This mode allows the precise calibration of the following scan modes:

- All voltages
- All resolution modes
- All rotation times

The tolerances for each mode are defined in the program and cannot be changed manually.

Required DFS mode can be selected manually and can be used for troubleshooting for any Image Quality problem.

Perform Detailed DFS Calibration in the following cases:

- After Mx8000 Software installation, when backup restore of the system tables was not performed
- After X-Ray Tube replacement
- After Tube Collimator parts, or the complete Tube Collimator, is replaced
- During periodic preventive maintenance.

NOTE:

Full Air Calibration should be performed after “Detailed DFS Calibration” and before clinical scanning.

XRT - Filament Calibration

Filament Calibration should only be performed from the host system.

NOTE:

Wait at least ten minutes after the last activation of the X-Ray Tube (X-Ray ON) before performing this calibration.

1. From the **Service** menu select **Filament Entry** to open the Filament Calibration Table.

   The Filament Calibration Table contains a number of different modes and the most recent date and time of calibration. There is also a choice of Standard (Small FS) or High (Large FS) Resolution.
2. Select the modes that you want to calibrate or select **ALL** to calibrate all modes.
3. Click **Scan** to start the calibration. When you are prompted to "Press OK for automatic scans", click **OK**.

   The date and time for the selected modes are updated in the table.

NOTE:

If you want to stop the calibration process at any time, click **Cancel.**

NOTE:

Wait at least ten minutes after filament calibration before starting any scans with the X-Ray Tube ON.

XRT - Current Calibration

⚠ WARNING

MAKE SURE THAT THERE IS NO ONE IN THE GANTRY ROOM BEFORE STARTING THE PROCEDURE.

1. From the **Service** menu, click **XRT-Current Calibration** to calibrate the tube emission current.
2. When the window opens, click **Calibrate**.

NOTE:

A message instructing you to re-position the Phantom may appear. Follow the on-screen instructions as they appear.

3. Check the images, and if they contain parts of the Phantom other than water, move the Phantom in the Z direction. Zero the bed position IN / OUT again and repeat the calibration.
4. Wait for the successful calibration message and then check if the calibration factor is lower than 1.11 (see *Table 12-1*.

Table 12-1: Calibration Factors

ITERATION	NOISE	DELTA NOISE	NEW TUBE LIMIT	NOMINAL LIMIT	CALIBRATION FACTOR	
1	13.75	2.0	0.19	1.30	1.00	CALIBRATING
2	13.58	0.03	0.19	1.30	1.03	SUCCESS

5. If the calibration factor is 1.11, perform **Z-Direction Calibration** (refer to the Mx8000 or Mx8000 Dual Physics files).
6. Perform two or three scans in different modes to ensure proper system functioning after the software upgrade.

UHR (Ultra-High Resolution)

This application is for the Ultra-high collimator adjustment.

NOTE:

Before Ultra-high collimator adjustment, perform Air Calibration at 120kV, High resolution mode, since this mode is used as a reference.

No air calibration is needed prior this check, but all air calibrations in Ultra-high mode should be performed after the collimator was adjusted.

The menu of this application contains the following programs listed below.

Diagnostic

This mode is used mainly for troubleshooting. In extreme cases it is also possible to update the specific mode by user defined values.

In this mode one can check the Axes, spacing for any allowed scan mode. The last used protocol appears upon entering the program. The user can modify the scan parameters. A window with latest calibrated XRT parameters (Delay, Amplitude and Offset) appears when pressing Continue. The user can change one or all of XRT parameters, and the scan is performed using these parameters. A result window shows the measured Axis and spacing values.

For hardware troubleshooting it is recommended to change the offset value in the “current” window by approximately 600 units and click the **Rescan** button. The average axis should shift by approximately 0.3÷0.4 detector units, if the axes values do not change, or change very little, there is a hardware problem.

To scan with another protocol, press Close, and enter again the Diagnostic program.

Axis On Prep

Use for troubleshooting purposes only and similar to.

Show Result

Displays the table with the last calibration results measured during automatic calibration in FIFO mode.

Parameters

This function allows the last Prep, created during the Diagnostic mode check for troubleshooting, to be displayed. To see the Prep data, run the Diagnostic mode, press PARAMETERS/SHOW PREP, and all 4 (or 2) slices are displayed in the view mode. In case of unstable DFS calibration behavior, it is recommended to check the Prep data for bad/dead channels, low or noisy signal (high or noisy Prep), and other artifacts.

This function allows changing the default detector range for Axis calculation for special purposes, for example: if the pin is shifted far off center for special Axis measurement.

Phantom Calibration

The phantom calibration procedure is improved for better ring and band artifact correction. It includes:

- Better DMS temperature stabilization by including 2 min. rotation before and between the calibration modes.

⚠ WARNING

THE SCANNER ROTATES BEFORE AND BETWEEN THE CALIBRATION MODES.

- The program utilizes now the channels defined as “**Bad Channels**.”
- Calibration takes about 25 minutes more.

Temperature Display

This feature, including “User Interface for Gantry” and “DMS” temperature display, could be used for service troubleshooting and during important calibrations, such as Phantom and Air Calibration.

From the **Service** menu, click **Show Temperature** and the temperature table appears after a few seconds. It can remain on screen during scans, calibrations or any scanner activity.

If the temperature is out of limits, its value appears on the bottom line in “red” typeface.

Lines with DMS temperature out of range are displayed in reverse mode.

The temperature is sampled each minute and/or when the scan is performed. The date and time is noted for each measurement, and almost a weeks history is retained for reference purposes.

If the temperature sensor is disconnected (e.g. the DMS cover is removed), it shows zero temperature value.

When the ASCII file, used to accumulate the data, reaches a certain limit, it is renamed and a new file is initialized automatically.

To save the current file, clickclick **Save**. The user can define a path (directory) and the file name. The saved file can be reviewed from the Temperature display window by clicking **Load**.

The renamed (backup) or current file can be sent to the Service center for analysis.

Tube History Display

This feature includes User Interface for Tube History display.

It could be used for service troubleshooting, for example: to check for tube arcing.

From the Service menu click Tube History and, after a few seconds, the tube history table appears. It can remain on screen during scans, calibrations or any scanner activity.

When the ASCII file, used to accumulate the data, reaches a certain limit, it is renamed and a new file is initialized automatically.

To save the current file, click click**Save**. The user can define the file's path (directory) and the file name. The saved file and can be reviewed from the Tube History display window by clicking **Load**..

The renamed (backup) or current file can be send to Service center for analysis.

The Error Log Analyzing Tools

LogOnline and LogViewer are tools for displaying and analyzing error log messages. LogOnline displays filtered error messages on their way to the error log file, and LogViewer displays the Logfile itself.

Error messages have identifying fields, such as date, time, and host. You can choose to display only selected fields, sort messages by one of these fields and filter messages by one or more fields.

With these error log analyzing tools, you can do the following:

- View a single error log.
- Filter by one field and one type at a time.
- Sort by one field at a time.
- Save a selection in a file.
- Display repeated messages as one entry, with a number in the **Freq.** field.
- Display HTML help on specific errors.
- Add a customized error message to the error log. For example, the error may contain information about the visit of the technician, and details about the problems and actions that were taken.
- Sort and/or filter using all fields.
- Use Histograms to display the distribution of errors by specific criteria.

Using LogViewer

From the **Patient Catalog** menu, select **Service** and click on **Error LogViewer**. By default (if no filter is selected) all error log messages automatically appear, sorted in reverse order by the time field.

LogViewer Menu Options

The **File** menu includes the following options:

- **SaveAs -** Save all the messages currently displayed in a file.
- **LogOut -** Log out from the USP applications.

- **Exit -** Exit from the LogViewer application.

Use the **View** menu to select the fields in standard error log messages. Select a button to include the corresponding field in the message list. Toggle it OFF to exclude the field from the list.

The **Tools** menu enables you to do the following:

- **Insert Error -** Open a dialog box that sends a new error to the error log. Use this option, for example, to log a special problem or to record a visit by a technician or support person.
- **Filter -** Display a partial error list, as indicated by the filter settings. As in the **View** menu, the **Filter** menu has a button for each field in an error log message.

  The **Date**, **Host**, **Application**, **Componnent** and **Code** fields each also provide a text field. Typing a valid value for these fields and pressing **OK** or **Apply** filters out messages that do not contain this value in the corresponding field. The resulting list includes only messages with the specified value in the corresponding field.

  In the **Level** and **Filter** fields, select a displayed value and press **OK** to display only messages that have same or a higher value in this field. For example, selecting **Info** as the **Server** filter displays messages that have **Info**, **Error** or **Critical** in that field.

- **Refresh -** Filter and sort the error log again, and update the display. Use this option to monitor the log from a local or remote station while the system keeps working.
- Histogram **-** Display the distribution of values in a selected field graphically. To change the selection, click on other fields in the header of the error list. This also sorts the messages by the newly selected field.

  For the **Date** field you can specify the distribution of messages in a histogram in terms of years, months, weeks, or days. The **Time** histogram may only be in terms of hours.

  In histograms for the **Host**, **Application**, **Component**, **H/S** and **Code** fields, values are arranged in alphabetic order. Histograms for the **Level** and **Server** fields are arranged by the possible values of this fields. No histograms are available for the **Message** or **Location** fields.

Displaying Help for Specific Errors

To display a Help dialog for a specific error, double-click the line for the selected error. The Help is based on HTML files located under **/usr/usp.root/html**. For each message there is one **html** file. Not all messages have HTML Help files. If there is no Help file, the message **File not found** is displayed.

Using LogOnline

Each entry in the error message log viewed using LogOnline is tested for filter criteria and displayed according to the specified view, as for LogViewer. However, the error message log viewed using LogOnline is not connected to the database of error messages. Therefore, sort operations are not available.

Using the Error Log

Currently, most Gantry related errors are thoroughly described in a corresponding HTML Help file, along with a possible cause and suggestions for correcting the situation.

These suggestions are based on tips gathered during integration, and from engineers in the field. Since the error log file is still under development, we will continue to monitor the program and welcome feedback from engineers in the field to help us improve it.

Not all the correction suggestions in the HTML file are appropriate for every situation. We advise you to use the basic diagnostics tools you have and your judgement based on your experience in applying these suggestions to solve problems appropriately.

To solve problems reported in the error log, we suggest that you do the following:

- First perform the obvious diagnostic procedures, such as: switching the system OFF and ON, logging out and then logging in again, checking power supplies, checking and adjusting the temperature.
- Always check all errors reported for the same time frame. Often, the true cause is not the first error, but is one that occurs later in the list.
- When you analyze a group of errors that are in the same time frame, checking the HTML file suggestions for all of them may help you determine a common cause.

The following is an example of appropriate use of the error log:

An axial scan was prepared. After pressing the **Manual Scan** button, the scan failed. The error log viewed using LogViewer showed a critical MCU error. Double-clicking on the error message displayed the following information from the HTML Help file:

> **Explanation:** ACU did not set signal ACQ_ok.
>
> **Possible cause:** Defective ACU, Defective ACQ.

When the same scan was repeated, the error occurred again.

The actual solution to the problem was to switch the Gantry OFF and then ON again. This cleared the error.

In this case, following only the HTML Help file directive, without trying other standard troubleshooting procedures would have been a mistake.

Communication (Data Path) Troubleshooting

Introduction

The purpose of this section is to help the service engineer solve the Communication error (MCU 00 00 54)—ACQ O.K. error with a troubleshooting procedure.

This document contains the following sections:

- Data Path FRUs and block diagram
- General tips
- A troubleshooting flowchart with step-by-step procedures

⚠ WARNING

**FOLLOW ALL SAFETY GUIDELINES AS DESCRIBED IN CHAPTER 1.
FAILURE TO DO SO CAN RESULT IN SEVERE PERSONAL INJURY.**

Data Path Field Replaceable Units (FRUs)

Table 12-2: FRUs in Data Path

FRU	P/N
RCOM card—Mx8000 Quad —Mx8000 Dual	474-7180-1010 470-7182-1012
W590 fiber optic cable—2 m	SP714690061
Receiver and transmitter	SP714807710
Slip Ring (The Capacitor Ring is part of the Slip Ring)	SP714805532
W376 fiber optic cable—5 m	SP713063401
W55 fiber optic cable—30 m	SP714695359
Acquisitor card	476-7180-1109
ACU card	SP714822586
MCU RTC card	SP714822503

NOTE:

The spare part numbers in the above table are valid at the date of this document. For the most up-to-date numbers, consult the official Spare Parts Catalog.

ACQ_OK

ACQ_OK is implemented between the MCU and the ACQ cards.

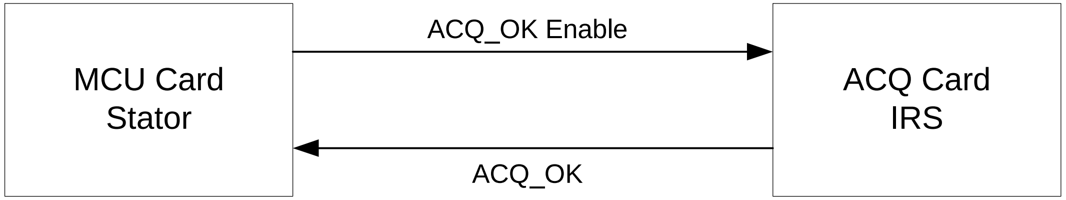


Figure 12-1:

The ACQ_Ok stops the scan if one of the following situations occurs:

- Patient was scanned and no date appears.
- Resend performed too often.
- Partial data collected during spiral or surview scans.
- Patient table position is incorrect.
- The ACQ card has difficulty transferring data to the SCSI disks because of SCSI performance problems.
- Numerous High Voltage drops occur.

Only ACQ_OK errors caused by communication faults are covered in this document.

Data Path Block Diagram

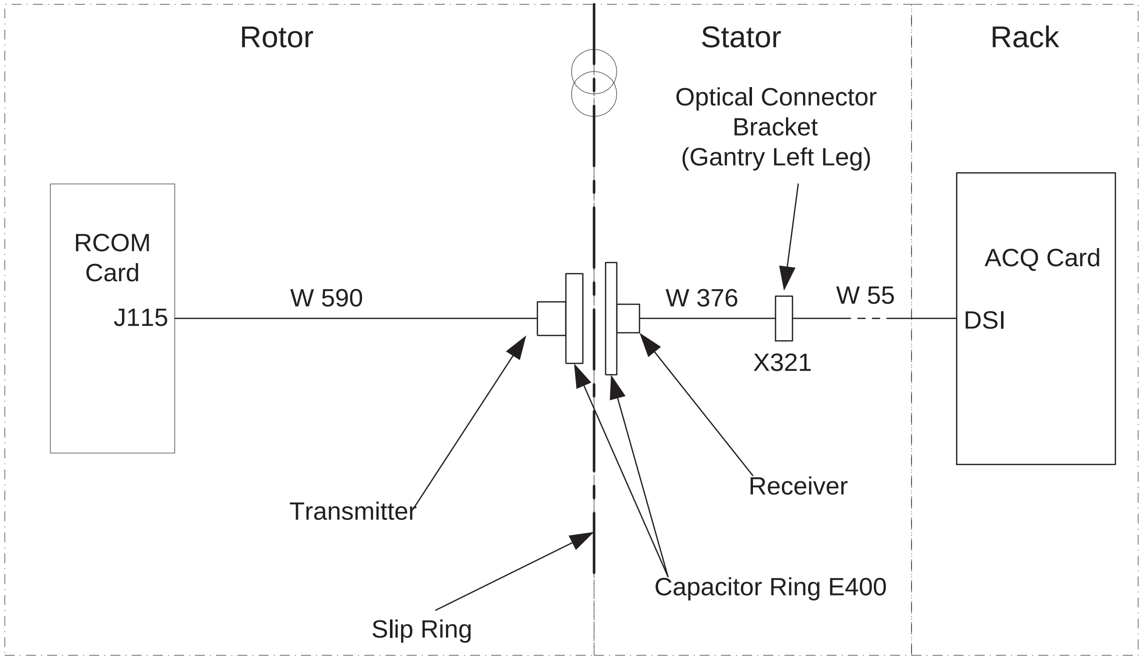

Rotor
Stator
Rack
Optical Connector Bracket (Gantry Left Leg)
RCOM Card
J115
W 590
W 376
W 55
ACQ Card
DSI
X321
Transmitter
Receiver
Capacitor Ring E400
Slip Ring

Figure 12-2: Data Path Block Diagram

ACQ Card Communication LEDs

Table 12-3: ACQ Communication LEDs

LEDS	DESCRIPTION
DS8B	If the green Communication LED is ON or blinking, communication is lost.
DS1B–DS7B	LEDs counter (resend mechanism).

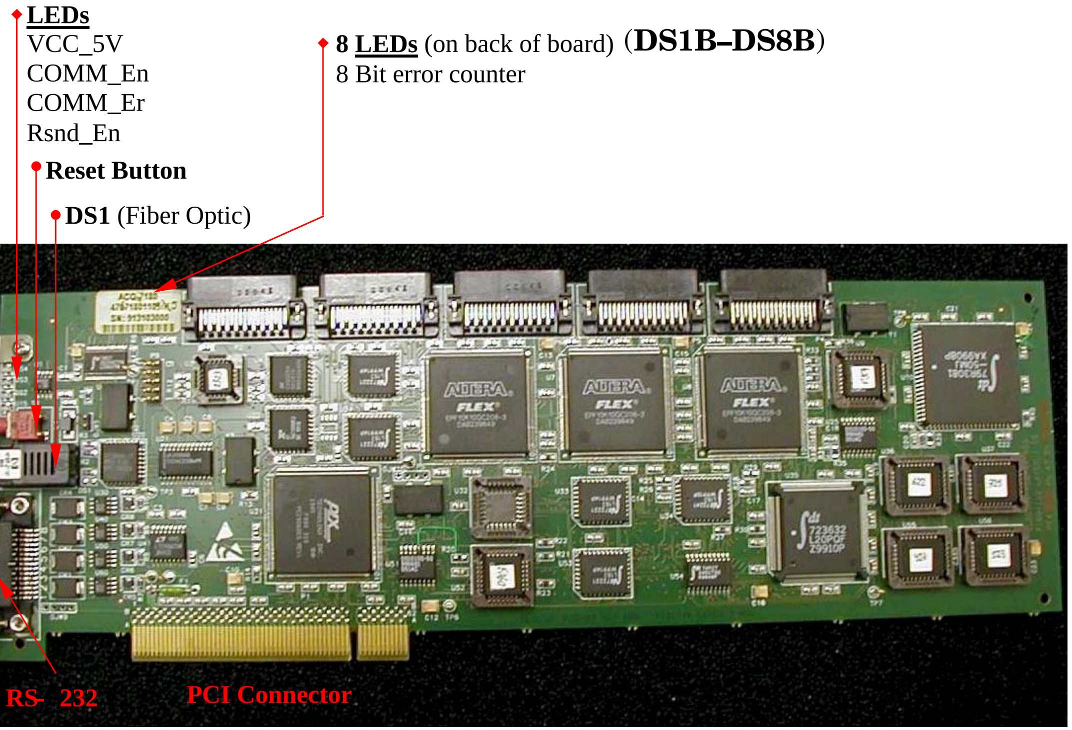

LEDs
VCC_5V
COMM_En
COMM_Er
Rsnd_En
Reset Button
DS1 (Fiber Optic)
8 LEDs (on back of board) (DS1B–DS8B)
8 Bit error counter
RS- 232
PCI Connector

Figure 12-3: Acquisitor Card

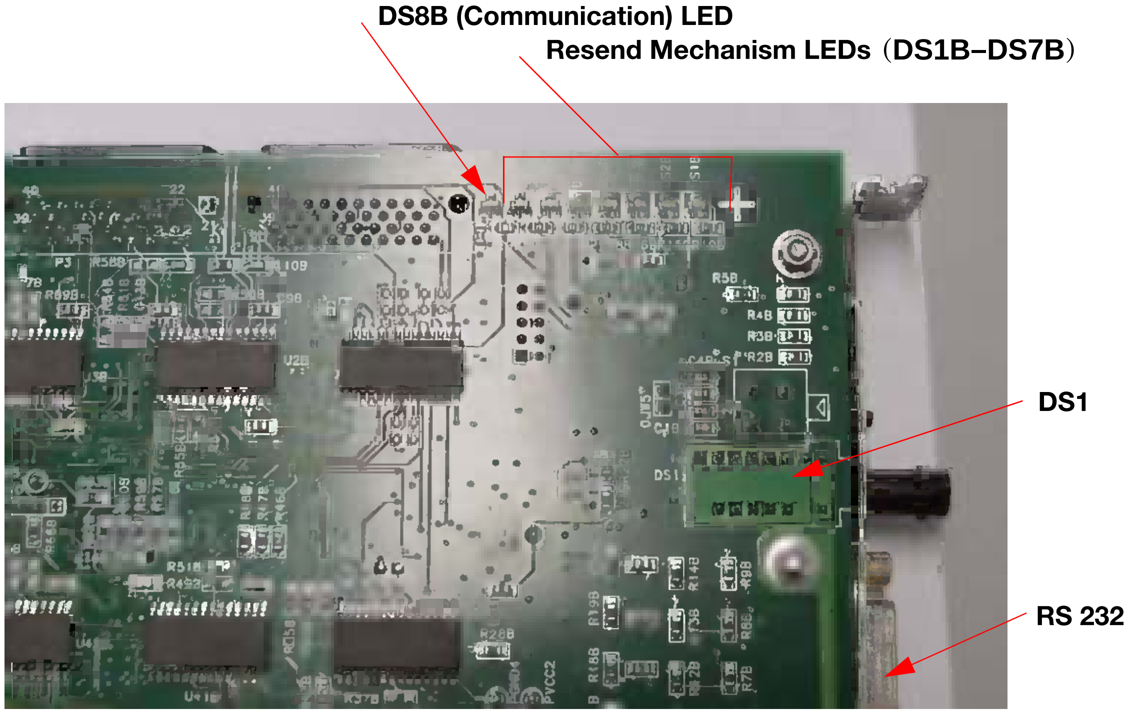

DS8B (Communication) LED
Resend Mechanism LEDs（DS1B–DS7B）
DS1
RS 232

Figure 12-4: ACQ—Rear of the Board

Resend Communication

The Resend mechanism is implemented between the RCOM and ACQ card.

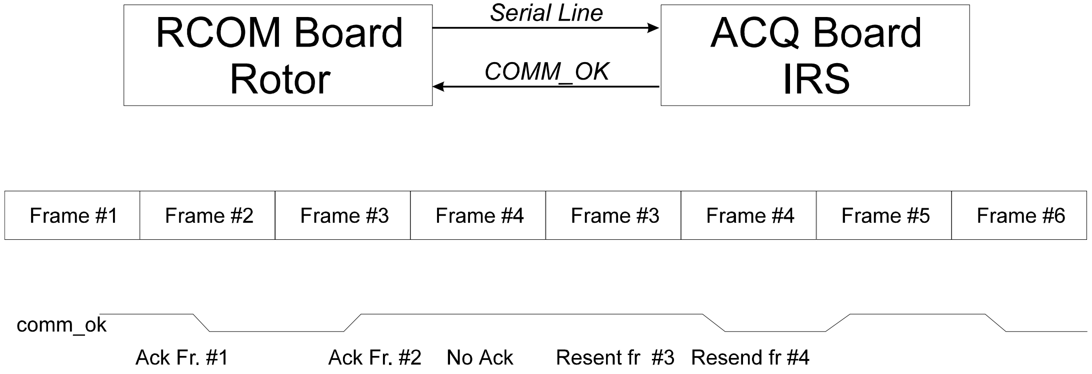

RCOM Board
Rotor
Serial Line
COMM_OK
ACQ Board
IRS
Frame #1
Frame #2
Frame #3
Frame #4
Frame #3
Frame #4
Frame #5
Frame #6
comm_ok
Ack Fr. #1
Ack Fr. #2
No Ack
Resent fr #3
Resend fr #4

Figure 12-5: Relation Between Frames and COMM_OK Line

Frames are transmitted on the serial line. The frames are checked in the ACQ card for CRC errors. The COMM_OK line is used by the ACQ card to inform the RCOM card about the quality of reception. The acknowledgement is done by the transition of levels of the COMM_OK signal.

General Tips

The error MCU 00 00 54 may also appear unrelated to a communication problem. Before starting the Communication (Data Path) troubleshooting, examine the following:

- IRS slowdown—can be caused by a problem with one of the IRS SCSI disks. Check for an error message in the ACQ monitor.
- Check for bent fiber optic cables on the ACQ card (W55) and on the RCOM card (W590). Rearrange the fiber optic cables, if necessary. The minimum radial bend circumference is 20 cm.
- Noise may be caused by unbalanced line input voltages. If either the Resend or Counter LEDs is lit, check the following:
    - The input line voltages to the Gantry
    - The voltage between ground and neutral is zero
    - The 3 phases of the input voltage are identical according to the Installation Manual
    - All ground cables are tightened
    - Slip Ring cleaning—Remove the carbon dust from the Slip Rings with a vacuum cleaner. Clean the Slip Ring with a tissue slightly sprinkled with 100% isopropyl alcohol.
- The majority of communication problems are caused by a defective receiver or transmitter.

⚠ **CAUTION**

ALWAYS USE AN ESD PROTECTION WRIST STRAP WHEN SERVICING ANY COMPONENT IN THE SYSTEM.

⚠ WARNING ⚠

ELECTROCUTION HAZARD! PRIOR TO ANY SERVICE AND MAINTENANCE ACTIVITIES INSIDE COMPONENTS:

- **SWITCH OFF THE SYSTEM AT THE MAIN POWER SUPPLY, (USING THE ON-SITE ON-OFF SWITCH) AND THE INTERNAL/EXTERNAL UNINTERRUPTIBLE POWER SUPPLY (UPS)**
- **MAKE SURE THAT NO OTHER PERSON CAN SWITCH ON POWER OR SWITCH OFF THE SECURITY MEASURES, WHEN INSTALLATION, MAINTENANCE OR SERVICE WORK ON THE SYSTEM IS PERFORMED.**

Error MCU 00 00 54

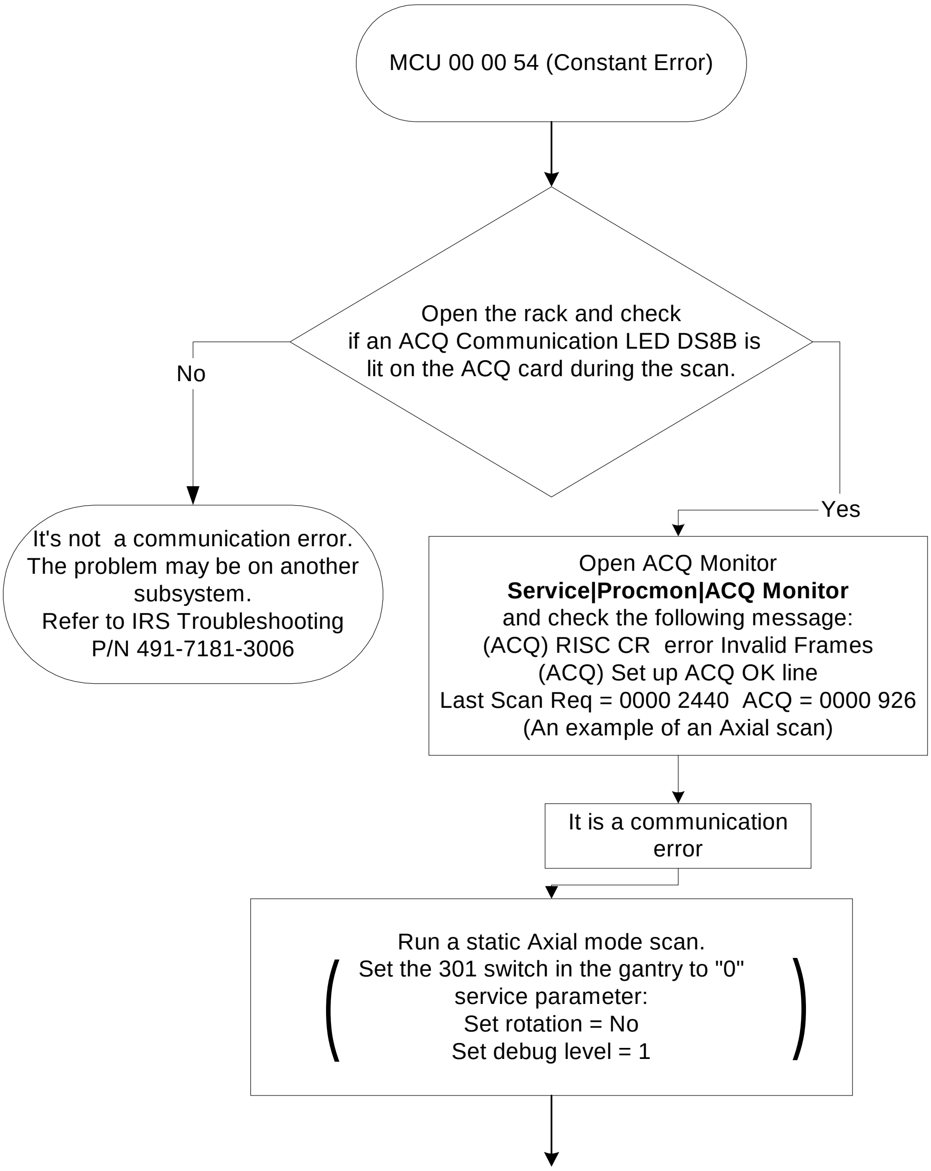
This error can occur as follows:

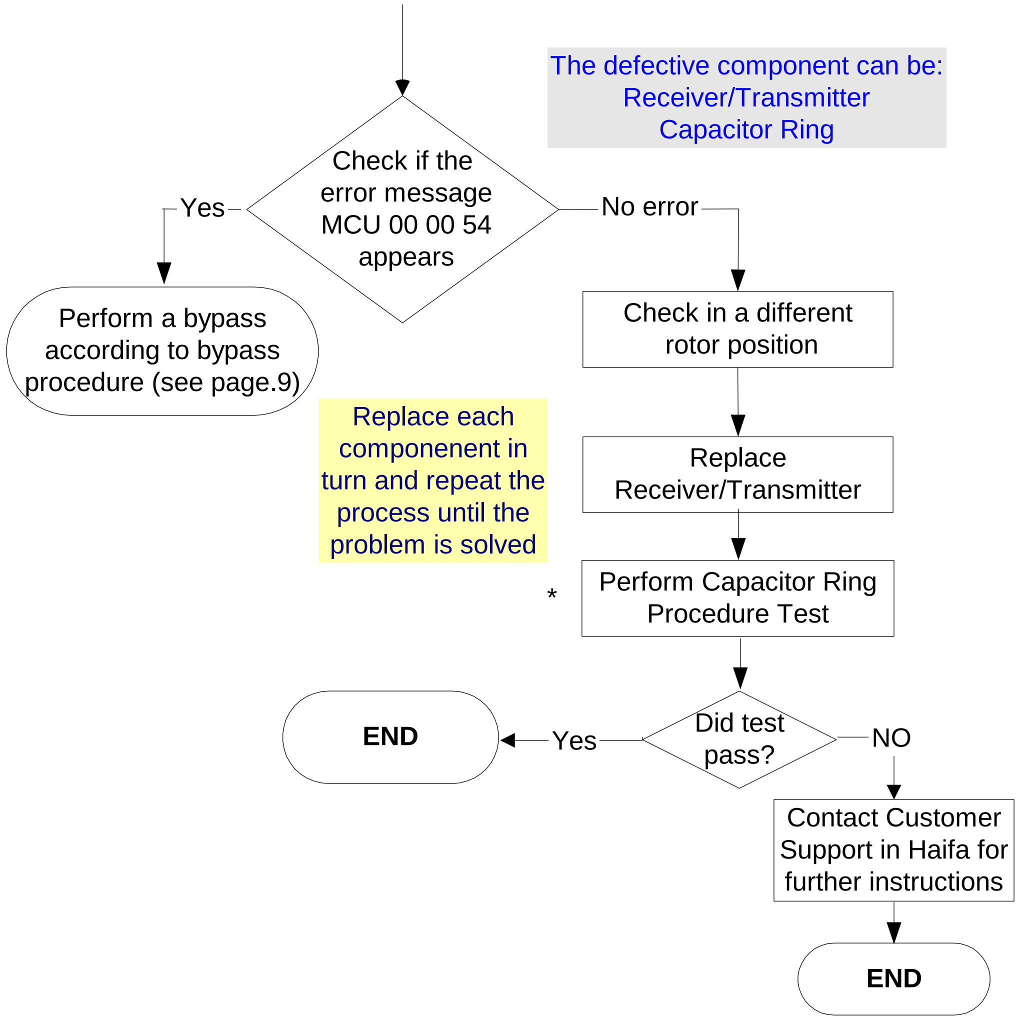
- Constant error, almost every scan (Scenario 1)
- Intermittent error, 2–3 times a week or less frequently (Scenario 2)

Scenario 1

Error MCU 00 00 54 (Constant Error)

Run scans in all modes (Axial, Helix, Surview).
Run a long Helix scan.

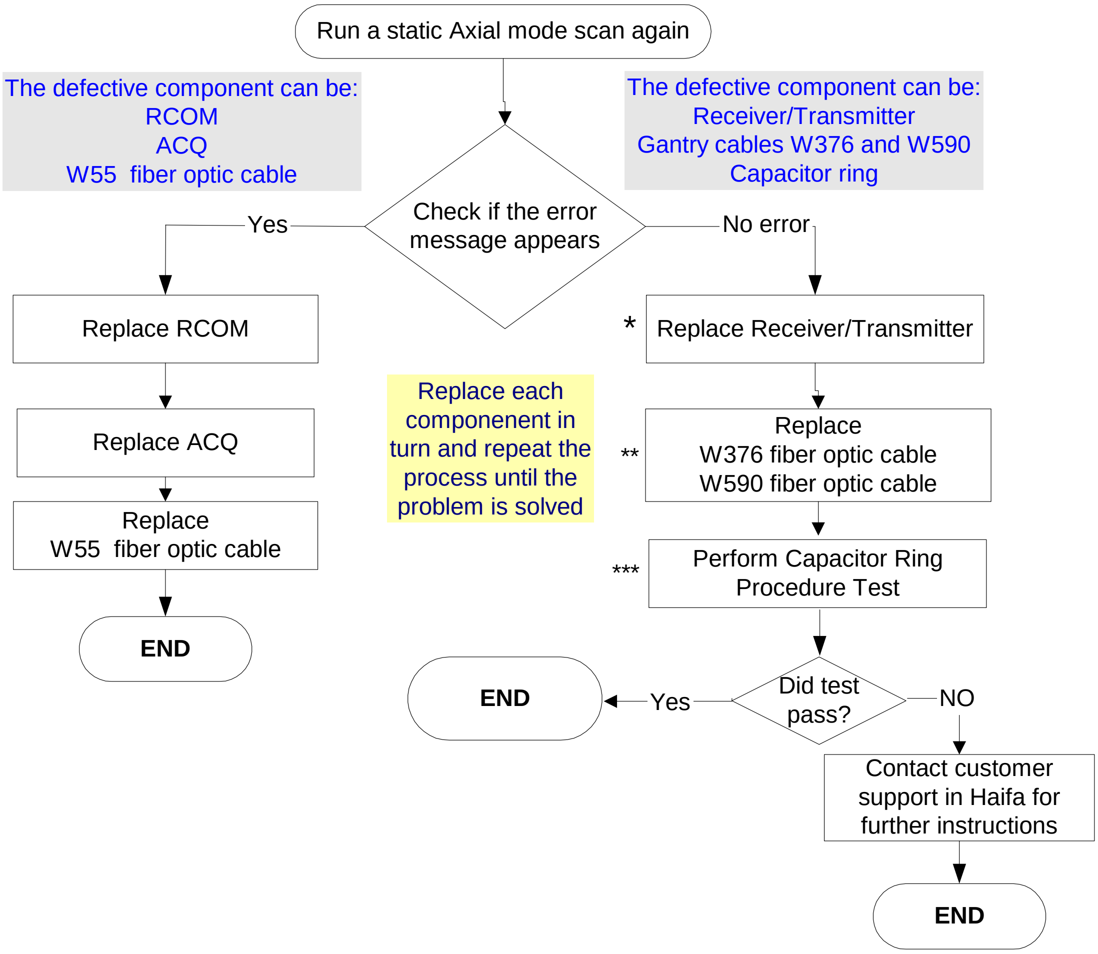

MCU 00 00 54 (Constant Error)
Open the rack and check if an ACQ Communication LED DS8B is lit on the ACQ card during the scan.
No
Yes
It's not a communication error. The problem may be on another subsystem. Refer to IRS Troubleshooting P/N 491-7181-3006
Open ACQ Monitor
Service|Procmon|ACQ Monitor
and check the following message:
(ACQ) RISC CR error Invalid Frames
(ACQ) Set up ACQ OK line
Last Scan Req = 0000 2440 ACQ = 0000 926
(An example of an Axial scan)
It is a communication error
Run a static Axial mode scan.
Set the 301 switch in the gantry to "0"
(service parameter:
Set rotation = No
Set debug level = 1)


The defective component can be:
Receiver/Transmitter
Capacitor Ring
Check if the error message MCU 00 00 54 appears
Yes
No error
Perform a bypass according to bypass procedure (see page.9)
Check in a different rotor position
Replace each componenent in turn and repeat the process until the problem is solved
Replace Receiver/Transmitter
*
Perform Capacitor Ring Procedure Test
Did test pass?
Yes
END
NO
Contact Customer Support in Haifa for further instructions
END

* Perform according to *"Capacitor Ring Test Procedure"*.

Bypass Procedure

Disconnect the W55 fiber optic cable from X321 (located at the bottom of the MCU card) and connect it directly to the RCOM card J115.


Run a static Axial mode scan again
The defective component can be:
RCOM
ACQ
W55 fiber optic cable
The defective component can be:
Receiver/Transmitter
Gantry cables W376 and W590
Capacitor ring
Check if the error message appears
Yes
No error
Replace RCOM
Replace ACQ
Replace
W55 fiber optic cable
END
*
Replace Receiver/Transmitter
Replace each componement in turn and repeat the process until the problem is solved
**
Replace
W376 fiber optic cable
W590 fiber optic cable
***
Perform Capacitor Ring Procedure Test
END
Yes
Did test pass?
NO
Contact customer support in Haifa for further instructions
END

CAUTION

* ALWAYS USE AN ESD PROTECTION WRIST STRAP WHEN SERVICING ANY COMPONENT IN THE SYSTEM.

** Refer to *Figure 12-2*

*** Perform according to *“Capacitor Ring Test Procedure”*.

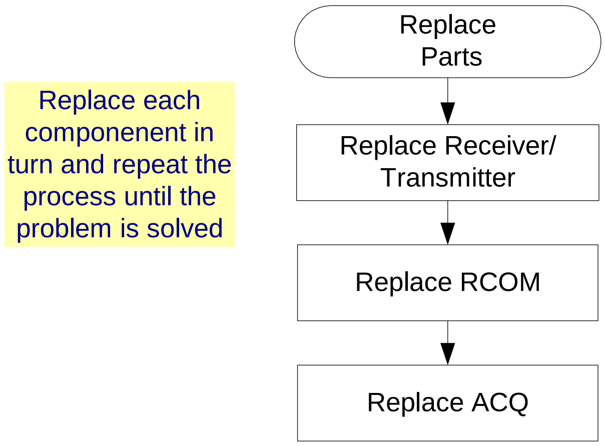
Scenario 2

Error MCU 00 00 54 (Very Intermittent)

The Resend LED is not lit (DS1B–DS7B refer to <Cross Reference>Fig.).

The error is not visible during a static scan.

The solution is to replace the following parts in this order:


Replace each componenent in turn and repeat the process until the problem is solved
Replace Parts
Replace Receiver/ Transmitter
Replace RCOM
Replace ACQ

Capacitor Ring Test Procedure

General

The purpose of this procedure is to help the FSE identify if the capacitor ring is defective.

Preparations

1. Move the couch max Out and max Down.

⚠ WARNING ⚡

ELECTROCUTION HAZARD! TURN THE SYSTEM COMPLETELY OFF USING THE SYSTEM SWITCHES AND THE MAIN POWER SUPPLY ON-SITE ON-OFF SWITCH.
ENSURE THAT THE SYSTEM CANNOT BE ACCIDENTLY TURNED ON.

⚠ WARNING ⚡

ELECTROCUTION HAZARD! BEFORE WORKING ON THE SLIP RING, WAIT AT LEAST FIVE MINUTES UNTIL THE CAPACITOR BANK IS COMPLETELY DISCHARGED.
CHECK THE YELLOW LED'S ON THE D450 BOARD INSIDE THE PDC UNIT.
TO ENSURE THAT THE CAPACITOR BANK IS DISCHARGED, MEASURE THE UDC VOLTAGE ON THE FOLLOWING POINTS:

- **UDC_POS AND UDC_NEG ON THE GENERATOR STATIONARY D450 BOARD**
- **UDC_POS AND UDC_NEG ON THE RIGHT GANTRY STAND (LEG)**
- **UDC_POS AND UDC_NEG ON THE SLIP RING GANTRY REAR SIDE**
- **UDC_POS AND UDC_NEG ON THE GENERATOR ELECTRONIC BOX**

2. Turn the system OFF as follows:
    a. Turn the Gantry Power OFF from the CT-Box.
    b. Perform Log out and Shut down of the Workstation.
    c. Turn the F1 switch, located in the PDC unit, OFF.
    d. Turn the main power on-site switch OFF.
    e. Remove fuses F100 and F200, located in the PDC unit (see *Figure 12-6*).
3. Open the Gantry covers as follows:
    a. Loosen two screws and open the Gantry front cover.
    b. Turn the S301 switch OFF.
    c. Loosen two screws and open the Gantry rear cover.

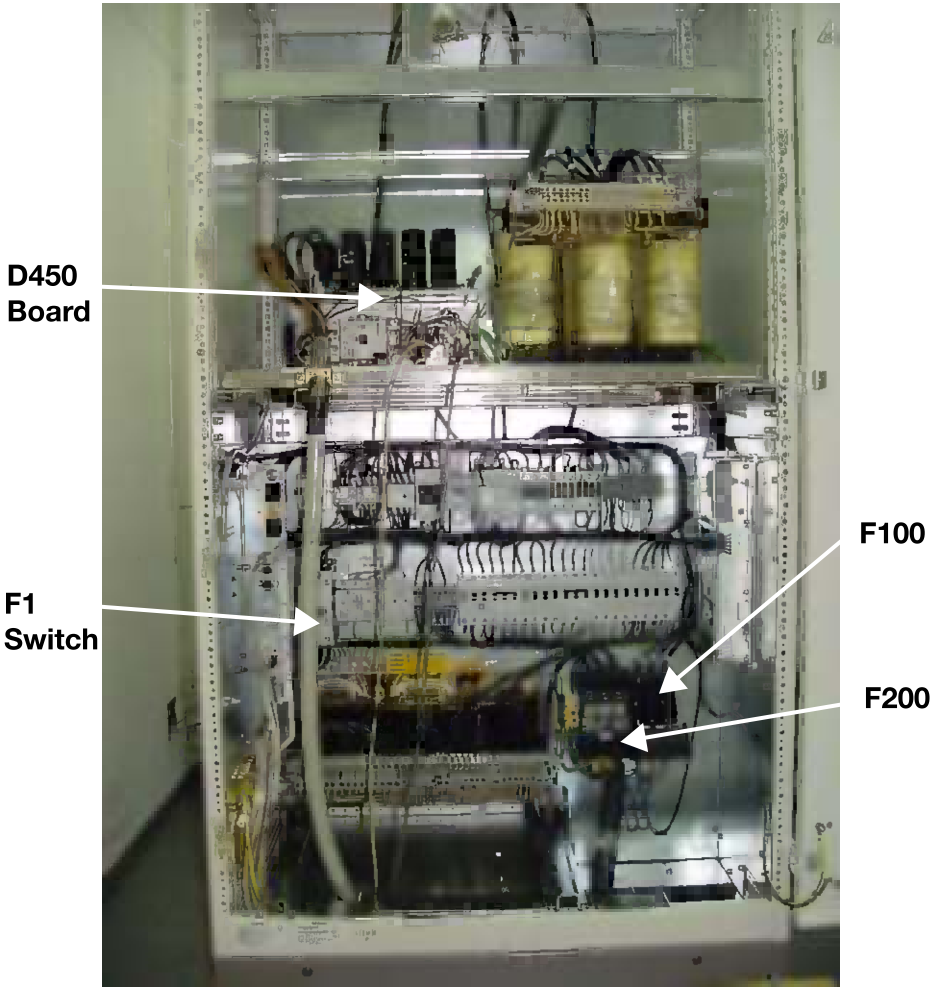


Figure 12-6: The PDC Unit

Removing the Funnel

Remove the funnel as follows (see *Figure 12-7*):

1. Rotate the rotor by hand to bring the DMS to a 6 o’clock position.
2. Disconnect the following connectors located on the upper-right side of the funnel:
   - — X312
   - — X325
3. Remove the four nuts holding the funnel.
4. Remove the funnel.

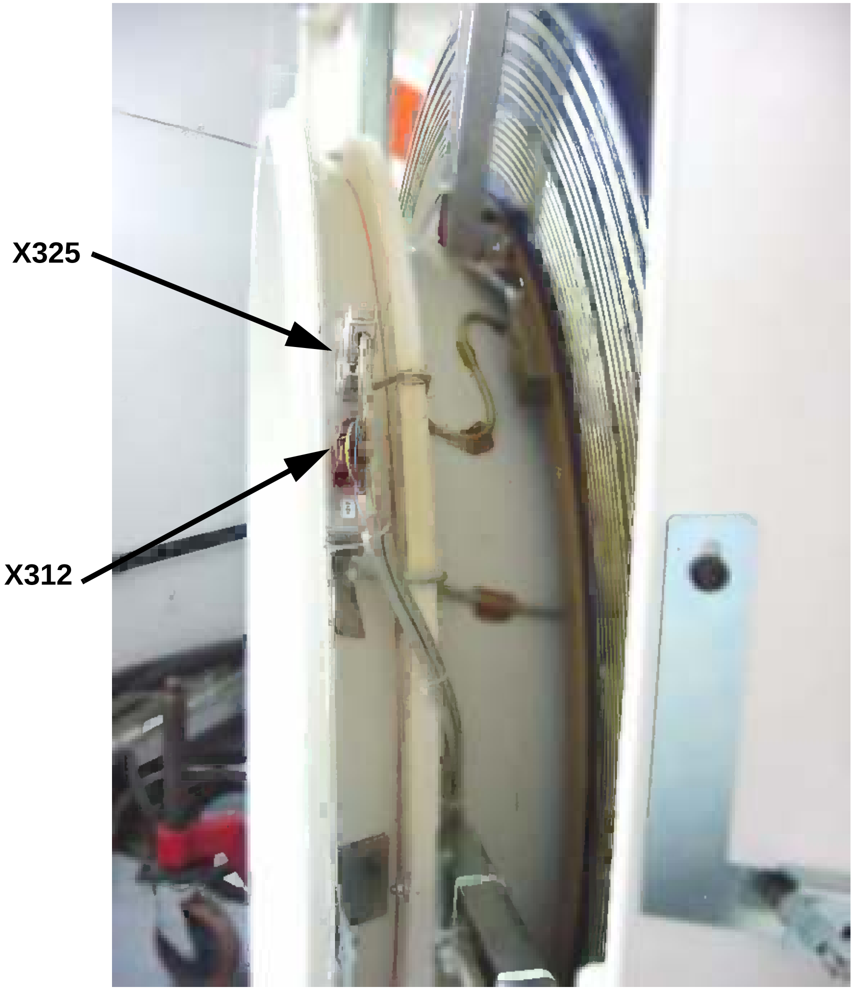


Figure 12-7: The Funnel

Electrical Test

Remove the electronic transmitter. Use a digital Multi meter (i.e. Fluke77) to measure resistance values at the following test points (see *Figure 12-8*).

TEST POINT	DESIRED VALUE
Pin 2/3 to A	8 Ohm +/-1 Ohm
Pin 7/8 to A	8 Ohm +/-1 Ohm
Pin 2/3 to 7/8	16 Ohm +/-2 Ohm
Pin 2/3 to B	0 Ohm +0,3 Ohm
Pin 7/8 to C	0 Ohm +0,3 Ohm

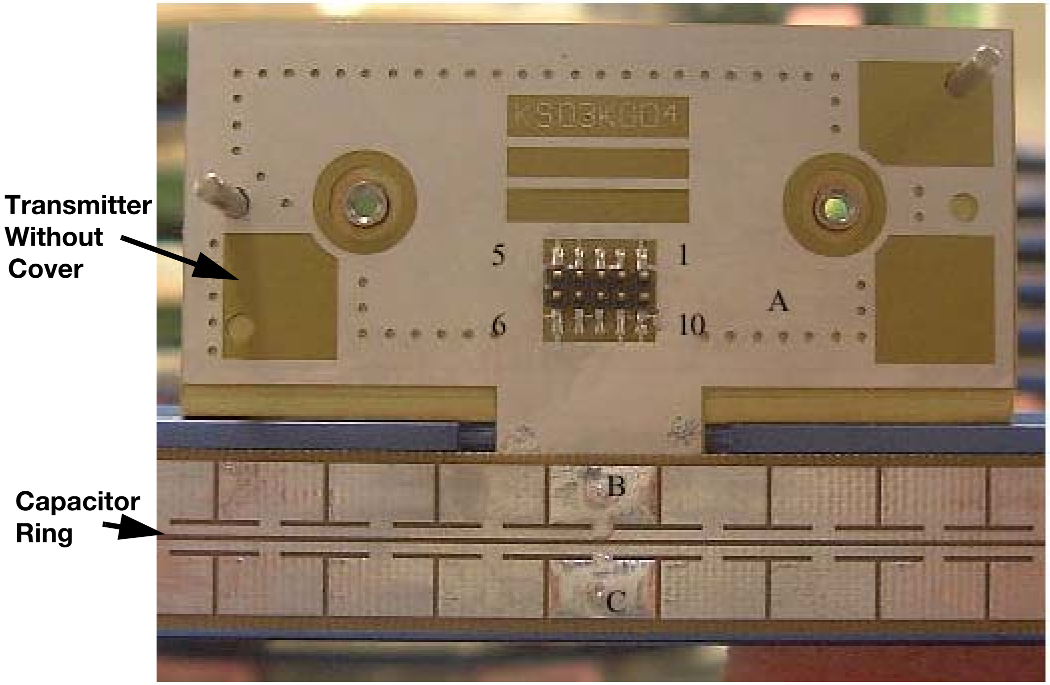


Figure 12-8: Transmitter Connectors

If this test procedure fails, replace the capacitor ring.

Visual Capacitor Ring Inspection

Mounting and Gluing

The data structure must be glued in equally. That means the structure surface must be at an equal level or lower than the inner diameter of the blue slip ring module, around the whole diameter (see *Figure 12-9*). Exception: area of termination resistors and solder points of transmitter connection. In *Figure 12-9* an erroneous situation is shown. The data structure **must not** come above the rim of the blue module. The structure is also not allowed to touch the receiver.

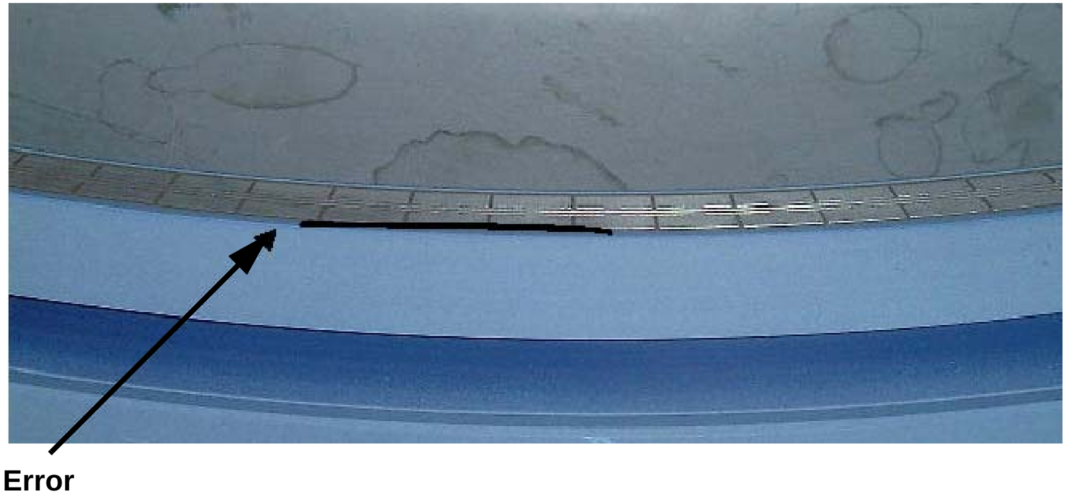


Figure 12-9: An Example of a Capacitor Ring with Error

Checking Ring Pad

Check for solder bridges between pads. A maximum of 3 pads each 20 pads may be connected together without causing problems (see *Figure 12-10*).

What to do:

Try to remove the solder bridges with a sharp knife or small screwdriver. If the data transmission problem still persists, slip ring replacement is required. Contact the customer service department in Haifa for further instructions.

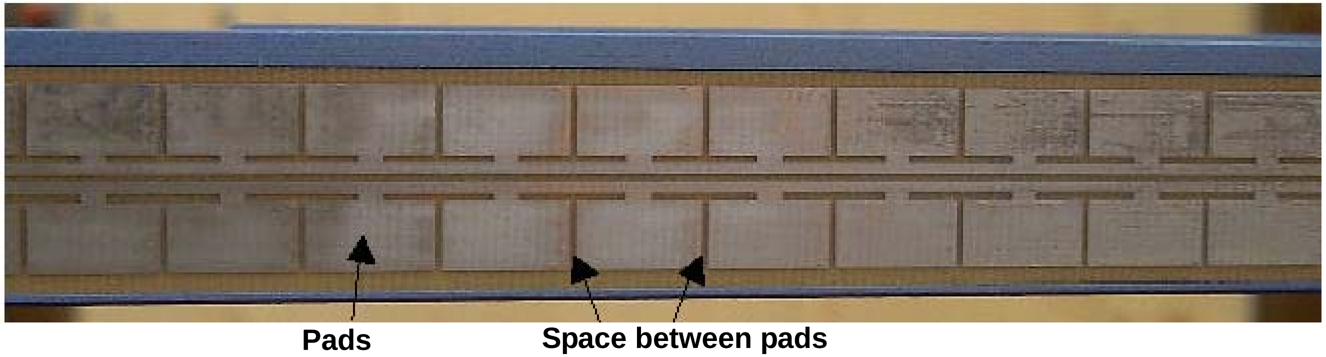


Figure 12-10: Capacitor Ring Pads

Replacing the Funnel

Return the funnel to its original position as follows:

1. Return the funnel to its original position.
2. Tighten the four funnel nuts to a torque of 10.2 Nm.
3. Reconnect the X312 and X325 connectors.
4. Return the Gantry rear cover.
5. Return the F100 and F200 fuses.

6. Turn the main power on-site switch ON.
7. Turn the F1 switch, located in the PDC unit, ON.
8. Turn the S301 switch ON.

Avoiding ESD Damage to Gantry Receivers and Transmitters

Overview

The purpose of this appendix is to instruct the FSE on the proper use of electrostatic discharge (ESD) protection when examination or replacement of the Gantry receiver / transmitter is necessary.

Error MCU 00 0054 is often solved by the replacement of the Gantry receiver / transmitter (Rx / Tx). Analysis of the faulty parts by the manufacturer showed that the majority of these parts were damaged by electrostatic discharge.

The Rx / Tx are very sensitive to electrostatic discharge. This requires the use of ESD protection when handling these parts. Failure to do so can cause their complete malfunction.

⚠ **CAUTION**

ALWAYS USE AN ESD PROTECTION WRIST STRAP WHEN SERVICING ANY COMPONENT IN THE SYSTEM.

Receiver / Transmitter Kit

CAUTION

THE RECEIVER / TRANSMITTER KIT IS ESD-PROTECTED (SEE *Figure 12-11*). HANDLE THE KIT ONLY WITH ESD PROTECTION.

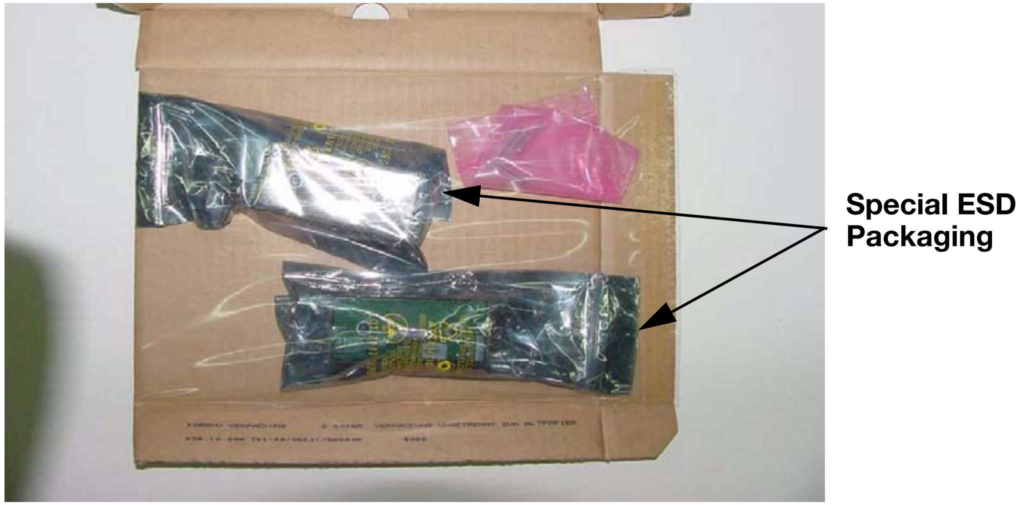


Figure 12-11: Transmitter/Receiver Kit

Procedure

If examination or replacement of the RX / TX is necessary, use an ESD wrist strap.

WARNING

ELECTROCUTION HAZARD! TURN OFF ALL POWER TO THE GANTRY.
SWITCH OFF THE F1 BREAKER IN THE PDC SO THAT THERE IS NO POWER TO THE DMS VIA THE SLIP RINGS.

Receiver

For receiver (Rx) examination or replacement, connect the ESD wrist strap to the PE (protective earth) in the rear of the Gantry as shown in *Figure 12-12*.

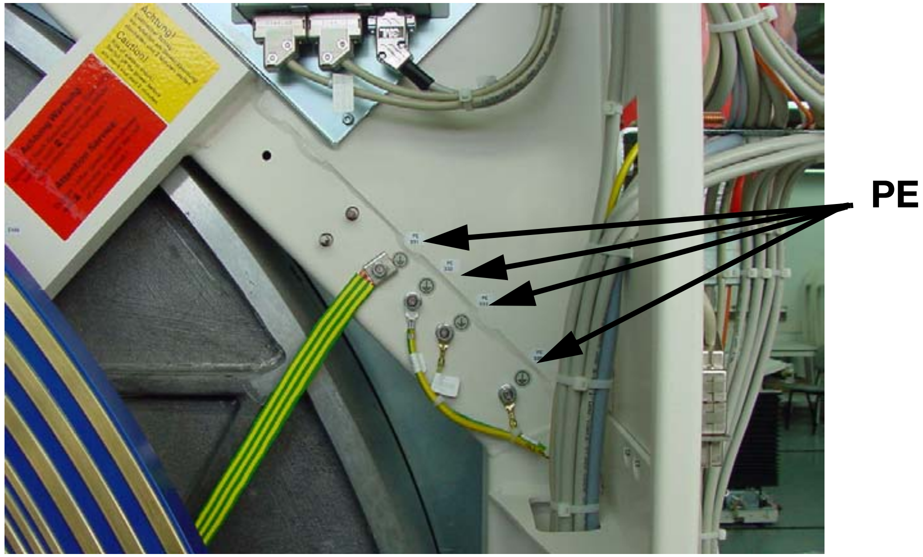


Figure 12-12: PE in Rear of Gantry

Transmitter

For transmitter (Tx) examination or replacement, connect the ESD wrist strap to the PE (protective earth) in the front of the Gantry as shown in *Figure 12-13*.

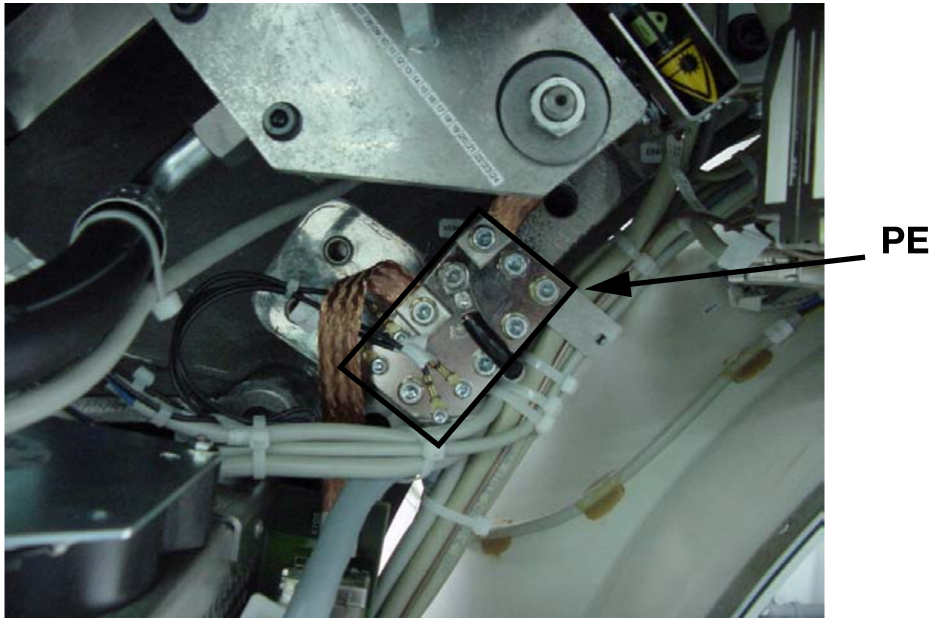


Figure 12-13: PE in Front of Gantry

Chapter 13
CANpro

CANpro 8.1 Service Instructions 13-1

Overview 13-1
Folder Structure 13-2
  Folders Downloaded from Site 13-3
  Scenarios Folder 13-4
  Important Note 13-5

CANpro Version 8.1 Installation Instructions 13-6

introduction 13-6
Prerequisites 13-7
  Parts Required 13-7
  Important Notes 13-8
Uninstalling CANpro Secure 4.8 Diagnostic Software 13-9
  Initial Conditions 13-9
Procedure 13-10
Pre-Setup installation for Windows 98 Systems 13-11
Pre-setup Installation for Windows 2000 Systems 13-14
Installing CANpro Can Test Tool Software 13-19
  Install CAnpro, Device Drivers & Machine Description 13-19
  Define Hardware for the Peak Can Device Driver 13-24
Ethernet Setup 13-26
  Introduction 13-26
  Procedure 13-28
Network Verification 13-32
  Initial Conditions 13-32
  Procedure 13-32
Connecting to the Scanner for the First Time 13-34
Updating CANpro 13-36

CANpro CAN Test Tool User’s Guide 13-39

Introduction 13-39
  Definitions 13-40
Getting Started 13-46
  How Does Canpro Run in Real-time on Windows 98/ME/NT/2000? 13-53
Safety Aspects of CANpro Use 13-55
  Thermal Load Calculator (Heat Calculator, TLC) 13-56
CANpro User Interface 13-57
  Menu Commands 13-58
  Shortcut Toolbar 13-75
  Status Bar 13-77
CAN Operation 13-78
  CAN Telegram Monitoring 13-78
  CAN Telegram Simulation 13-81
  Loading and Checking Scenario Files 13-82
  Scenario File Execution 13-83
CANpro User Tips 13-89
  Evaluating Protocol Files on a PC without any CAN Card 13-89
  Performing Long-Term Monitoring during One or more Weeks . . 13-89

  Continuing a Sequence of Autonumbered Protocol Files 13-90
Flash Load and Read 13-91
  Loading Firmware to the Gantry 13-92
  Reading Firmware from the Gantry 13-95
  Updating CANpro with Firmware Versions 13-99
  Updating CANpro with Additional Error Documents 13-100
Troubleshooting 13-101
  Initialization Errors 13-101
  Error Message when Exiting CANpro or Changing the Machine while a Scan is Running 13-104
  CANpro Cannot Send or Receive Telegrams 13-104
  Memory Problems 13-105
  Disk Space Problems 13-105
  CAN Driver or Card Errors 13-105

CANpro 8.1 Service Instructions

Overview

Version CANpro 8.1 is compatible with the Mx8000, Mx8000D, and Mx8000 IDT systems.

CANpro 8.1 is similar to the CANpro 7.5, used in the Mx8000 and Mx8000D systems.

⚠ **CAUTION**

TO AVOID X-RAY TUBE DAMAGE, READ AND IMPLEMENT WARNING MESSAGES WHEN PERFORMING SCANS WITH X-RAY RADIATION.

Folder Structure

The folders for the Mx8000 diagnostic program are created during CANpro software installation on the laptop. They are organized as shown in *Figure 13-1*.

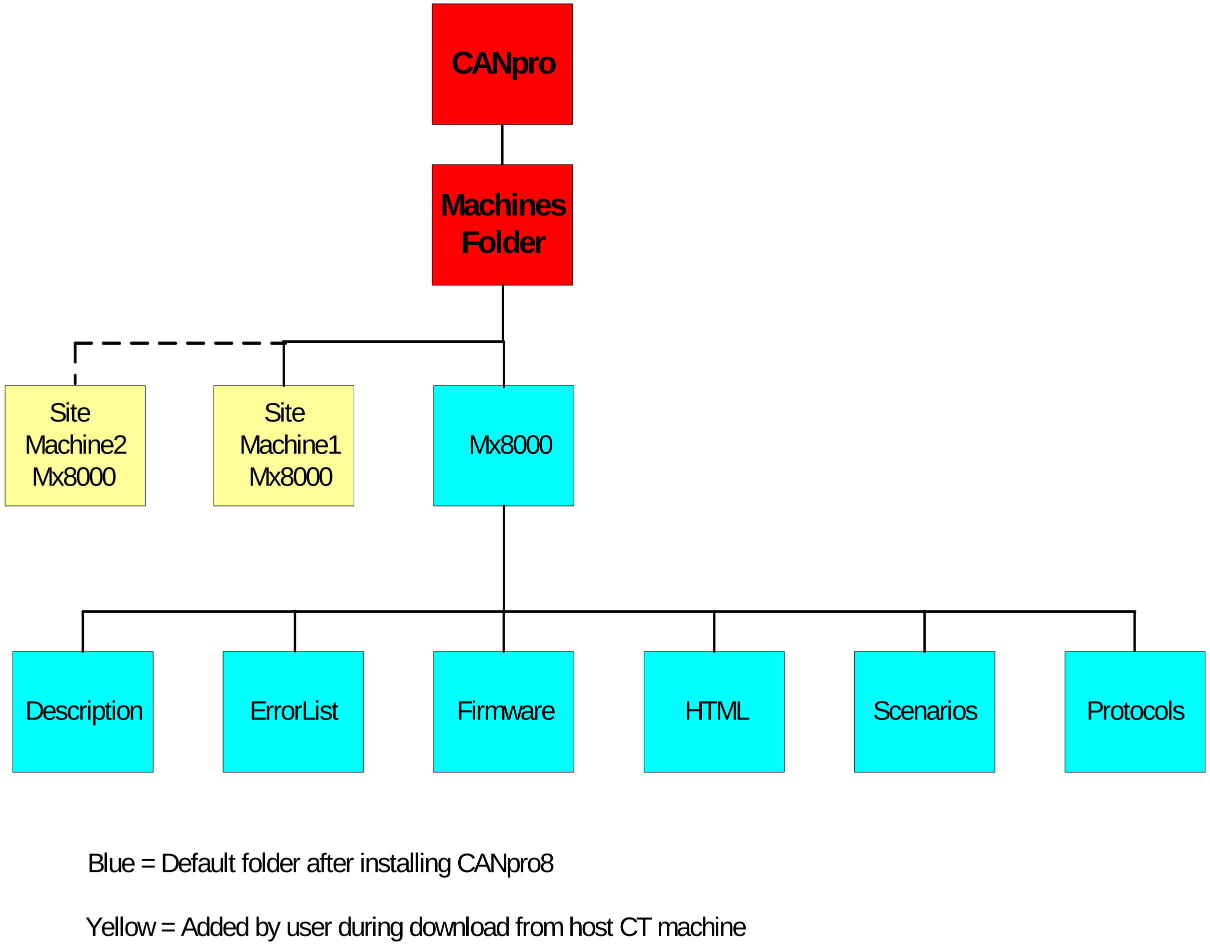

CANpro
Machines Folder
Site Machine2 Mx8000
Site Machine1 Mx8000
Mx8000
Description
ErrorList
Firmware
HTML
Scenarios
Protocols
Blue = Default folder after installing CANpro8
Yellow = Added by user during download from host CT machine

Figure 13-1: Folder Structure Diagram

Folders Downloaded from Site

The following folders (see *Figure 13-2*) are created during synchronization with the CT Host computer:

- **HTML folder** contains solutions for errors reported by the scanner
- **Protocols folder** contains CANpro log files created while monitoring the Gantry.
- **Description folder** contains description files for the CANpro program
- **Firmware folder** contains the list of hardware firmware versions that are installed in the machine. To update firmware refer to the CANpro Tool User’s Guide.
- **Scenarios folder** contains three sub-folders; Adjust, Diag, and Init

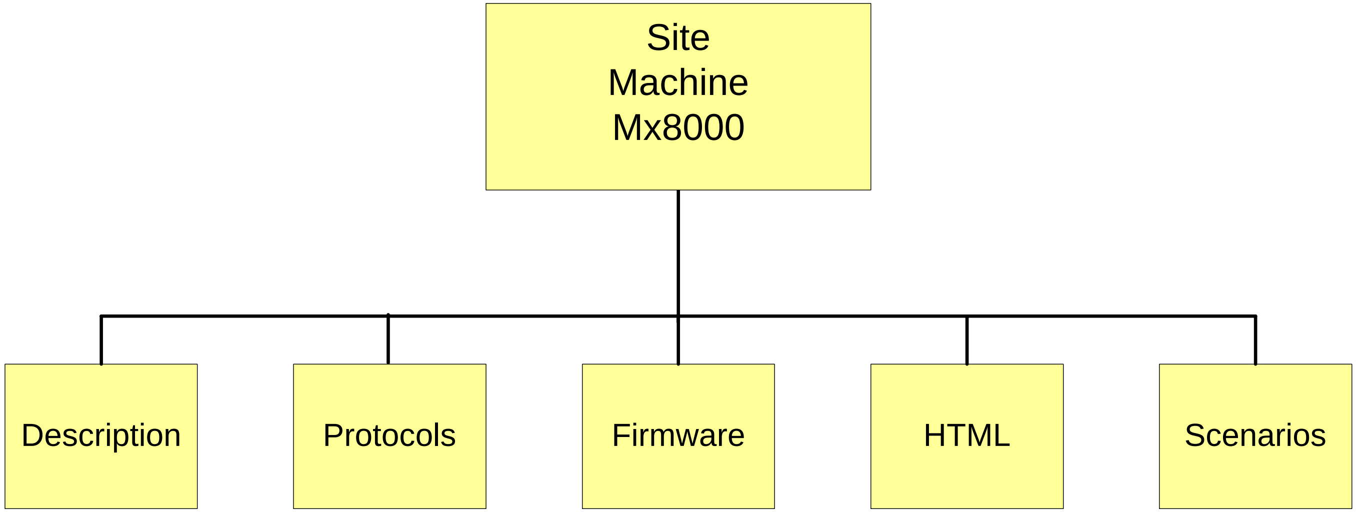


Figure 13-2: Folders Downloaded from Site Diagram

Scenarios Folder

The Scenarios folder contains the following three sub-folders (see *Figure 13-3*):

- **Adjust folder** contains calibrations sequences such as frequency adaptation, tube conditioning, etc.
- **Diag folder** contains special sequences such as surview, spiral, and XRS tests
- **Init folder** contains files to bring the scanner to the standby state, including system tables and a scenario to load them

For troubleshooting in CANpro 8.1, new X-ray scenarios can be defined with the Manual X-ray tool (see CANpro Tool User’s Guide).

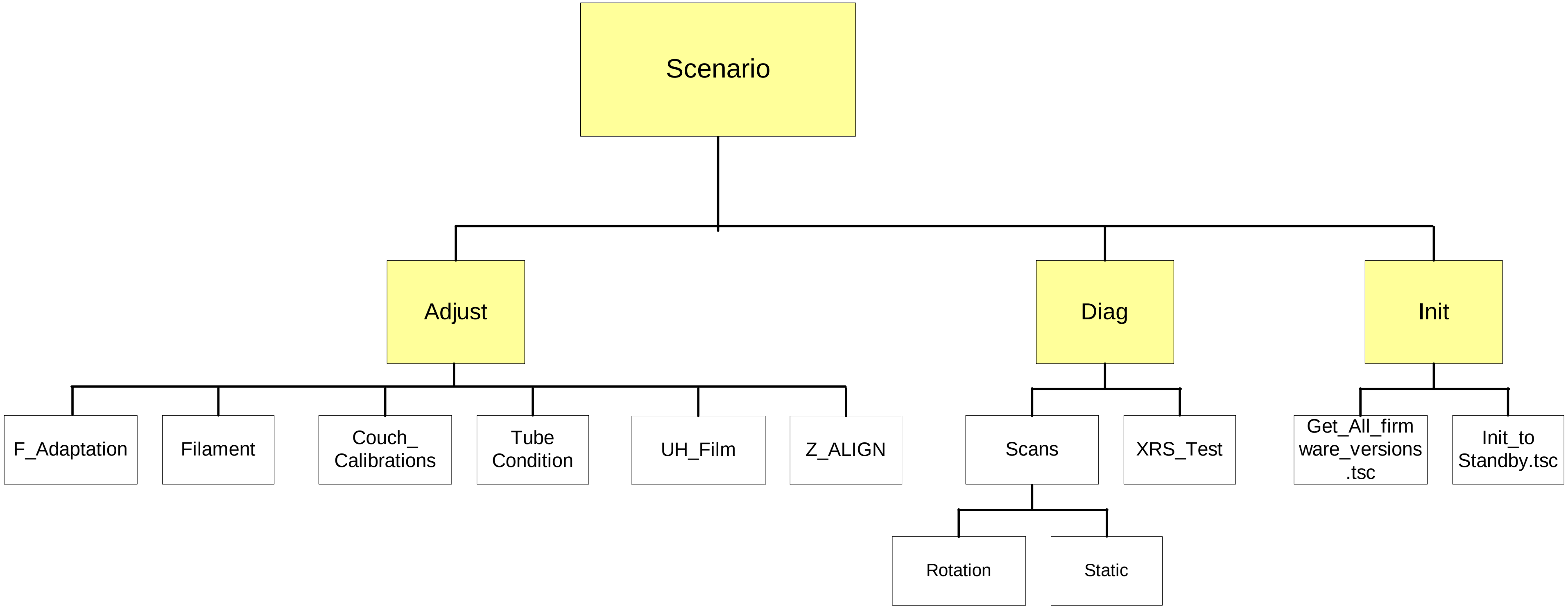
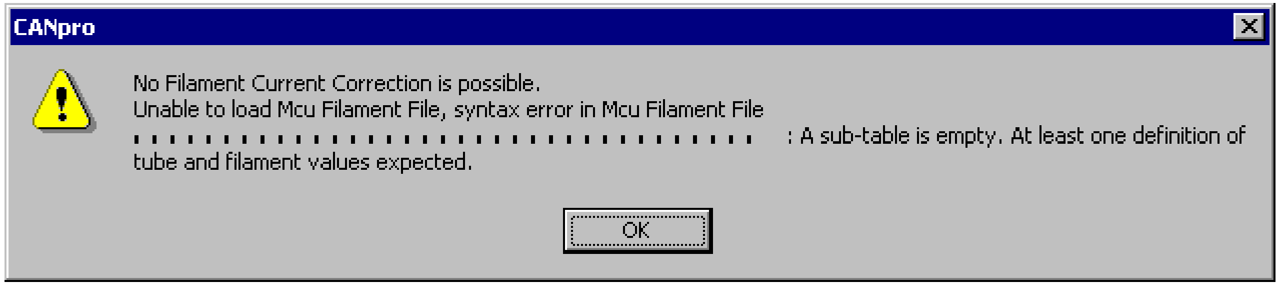

Scenario
Adjust
Diag
Init
F_Adaptation
Filament
Couch_
Calibrations
Tube
Condition
UH_Film
Z_ALIGN
Scans
XRS_Test
Get_All_firm
ware_versions
.tsc
Init_to
Standby.tsc
Rotation
Static

Figure 13-3: Scenario Folder Structure

Important Note

While connecting the CANpro to Host, files from the version 2.5 are copied to the Laptop. After file copy is finished, a message appears (see *Figure 14*).



No Filament Current Correction is possible.
Unable to load Mcu Filament File, syntax error in Mcu Filament File
▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮ : A sub-table is empty. At least one definition of tube and filament values expected.

Figure 14:

This message appears while working with **Dose Modulation**, a new application of v2.5. The **mcufilament.cfg** file was changed with new values for dose and Canpro identifies this change.

Practically, this means you can not use the **Simulation** | **Load with filament correction** command (the command is unavailable on the menu).

The **Simulation** | **Load with filament correction** command allows you to run a specific scenario with the filament correction of the specific tube of the clinic system while the CANpro is synchronized with the host computer. That means the values in the table of the scenario are changed with the filament correction for the specific parameters adopted by the scenario.

Since the **Simulation** | **Load with filament correction** command is unavailable, load scenarios from the folder you downloaded from the Host or from the default **Mx8000 IDT/scenarios/** folder. Select **Simulation** | **Load**, open the folder and choose a scenario. Press **F4** or from the **Simulation** menu, or click **Start**.

The following tables lists the scenarios in the scenario folder:

CANpro Version 8.1 Installation Instructions

introduction

CANpro Test Tool Software can be installed on any laptop (notebook) or desktop PC to perform a variety of tasks necessary to maintain an Mx8000 / Mx8000 IDT CT Scanner running at optimum performance. After you have completed all sections of this instruction, the CANpro Test Tool software will be installed on your PC and will be able to communicate with the scanner's host computer and monitor the scanner's CAN bus.

This installation instruction guides the user through the following separate procedures:

1. Removal procedure for CANpro Secure 4.8 Diagnostic software

> **NOTE:**
>
> If you are not sure whether or not the 16 bit version of CANpro has ever been installed on the PC you are using, you must perform steps 9 and 10 of the CANpro Secure 4.8 Diagnostic software removal procedure (*see "Uninstalling CANpro Secure 4.8 Diagnostic Software" on page 13-9*). This ensures that all instances of CANpro are removed from the registry. Communication with the scanner's host computer can be affected by any instance of CANpro in the registry that is not added during the installation.

2. Pre-setup Installation for Windows 98 and Windows 2000.
3. Installation procedure for CANpro CAN Test Tool software.
4. Installation procedure for the Peak-CAN device driver.
5. Ethernet Setup.
6. Network Verification.
7. First-time operation of CANpro CAN Test Tool Software.
8. Updating CANpro to a new version.

Prerequisites

- The Mx8000 CT Scanner must have version 2.2 Software or higher installed.
- A laptop or desktop PC with the following minimum requirements:
  - — Windows NT 4.0, Windows 98, Windows 2000 or Windows Millennium (ME)
  - — 200 MHz Pentium II (or compatible)
  - — 50 MB free disk space
  - — 64 MB RAM
  - — 125 MB paging file size
- CAN communication card or PEAK CAN dongle supported by CANpro.
- Security dongle or K2000 security software enabled and running on the CANpro PC.
- Any version of CANpro older than version 6.15 must be completely uninstalled from the PC.

Parts Required

CANpro Version 8.1 CD-ROM P/N 485-7200-0210

Important Notes

- It is undesirable for the hard disk or the monitor to switch off while running any tests. Power Management must be removed (i.e uninstalled) from any PC running Windows 98, Windows 2000 or Windows ME on which CANpro CAN Test Tool software is to be installed. Conflicts between power management and the PEAK CAN device driver prevent CANpro CAN Test Tool Software from operating correctly.
    - **Windows 98:** Power Management is based on a driver that runs continuously in the background. This driver can cause the CPU to run more slowly which, in turn, causes the PEAK CAN driver to execute more slowly. If the CPU is running slow or is changing state at a time when the PEAK CAN dongle receives many CAN messages in a short space of time, the machine cannot keep pace with every interruption and fetch a message from the hardware register before another arrives. This condition is known as hardware overrun.
    - **Windows 2000:** The operating system forces some hardware interrupt requests (IRQs) to serve multiple device drivers due to serious bugs in Windows 2000 advanced power management. The PEAK CAN device driver requires an unshared IRQ. When you attempt to define the CAN hardware using a “shared” IRQ, the computer displays a blue screen, reboots and the CAN hardware remains undefined.
- You must have administrator privileges on the installation PC to correctly install the security dongle software.
- Uninstall any version of CANpro older than 6.15 before attempting to install CANpro CAN Test Tool software.

⚠ CAUTION

NEVER INSTALL OR REMOVE A CAN DONGLE FROM A WINDOWS SYSTEM THAT IS UP AND RUNNING!

- The security dongle is static-sensitive and should be carried in a static-protective bag.
- The Peak CAN Parallel to Serial Adapter Dongle (P/N T99Q-1003) and Security Dongle (P/N T99Q-1004) used with CANpro (Secure 4.8) may be used with CANpro CAN Test Tool S/W.
- The Security dongle is unnecessary if the following two conditions are met:
    - K2000 decryption software is installed on the PC and enabled with an unexpired Visa.
    - The registry is updated with the authorized application list (authlist) that includes CANpro.exe

- The authlist registry entries for K2000 are updated every time the ServiceNet K2 Visa Renewal Client is successfully executed. Visas are renewed for a 10-day period by the ServiceNet K2 Visa Renewal Client when there is less than 5 days remaining on the Visa. Extended Visa validity may be obtained from a K2000 Visa Administrator for special business needs.

Uninstalling CANpro Secure 4.8 Diagnostic Software

This section instructs the user how to remove the old CANpro software. The CAN driver used by the older software conflicts with the newer driver and must be removed.

NOTE:

If you are unsure of the history of your PC and do not know if the 16-bit version of CANpro has ever been installed Perform steps9 and 10 below.

Initial Conditions

- The PC is up and running
- A CD-ROM drive is installed

NOTE:

Since drives are labeled differently on various systems, this document will refer to the letter designation associated with the CD-ROM drive simply as **CD-ROM:**\.

Procedure

1. Boot up the laptop computer with CANpro 4.8 Secure software installed.
2. Insert the CANpro Test Tool CD into the CD-ROM drive.
3. In Windows Explorer, open **C:\Windows\System**.
4. Right-click the file Peakcanl.386 and select **Properties**.
5. Verify that the **Read-only** option is disabled. If **Read-only** is enabled, click to clear it. Click **Archive** to enable the Archive option attribute.
6. Click **Apply** and then **OK** to accept the settings and close the dialog box.
7. In Windows Explorer, open **CD-ROM:\Tools\CANpro4.8.Uninstaller** and double-click **CANpro 4.8.Uninstaller.exe**.
8. Click **Uninstall** and then **OK**. The program automatically removes files installed during CANpro 4.8 setup.
9. In Windows Explorer, open **CD-ROM:\Tools\CANproCleaner** and double-click **CANproCleaner.exe**.

NOTE:

If a user profile for more than one user exists on the PC, every user with a profile that invokes CANpro must run CanproCleaner.exe to remove all registry entries for CANpro.

10. Make sure the check boxes for both options (clean current user info and clean general info) are checked. Click **OK**. The program automatically removes registry entries associated with CANpro 4.8 installation.

11. Save any files in the C:\Mx8000 folder to a different folder.
12. In Windows Explorer, select the Mx8000 folder to highlight the folder and click **Delete**.
13. Click **Yes** to remove the folder Mx8000 and move all its contents to the recycle bin. CANpro Secure 4.8 software is now completely removed from the PC.
14. Restart the PC. Enter Setup during the PC’s boot process to prepare for the next step.

Pre-Setup installation for Windows 98 Systems

1. Turn on the PC and enter the BIOS/CMOS Setup.
2. Record the default hardware address and IRQ assigned to the parallel port intended for use with the PEAK CAN dongle. Use these settings at the point in the installation where hardware for the PEAK CAN device driver is defined. The following settings are recommended:
   - I/O Address: 0378
   - Interrupt: 07
3. Change every existing setting referring to power management from **ENABLED** to **DISABLED**.
4. Change the parallel port to EPP mode (or ECP if EPP is unavailable).
5. Choose the option to **Exit the BIOS/CMOS Setup** while saving changes and allow the PC to restart.
6. On the **Start** menu, click **Settings** and then click **Control Panel**.
7. Double-click the **Power Management** Icon *(Figure 13-1)*. (Windows ME users select Power Options).

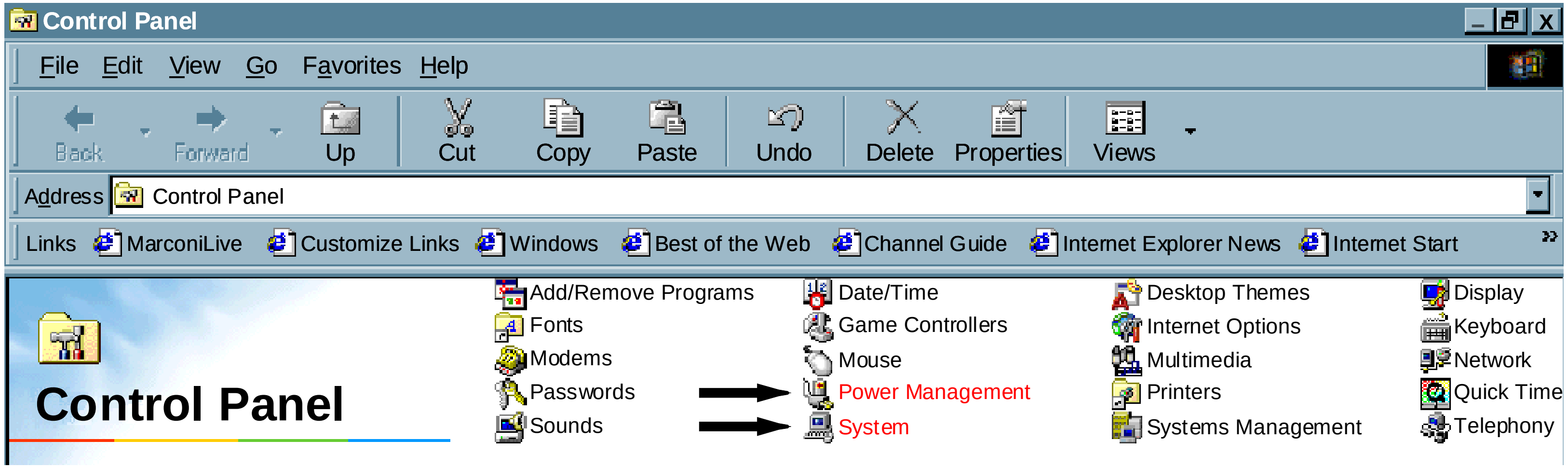
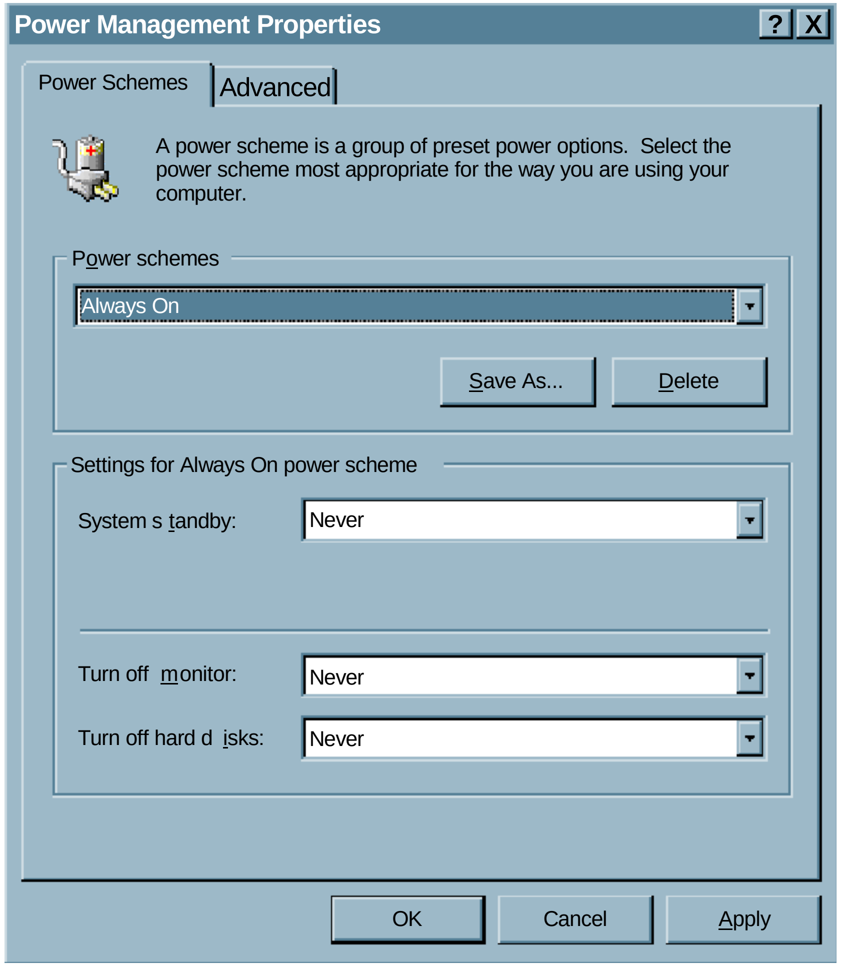

Control Panel
File
Edit
View
Go
Favorites
Help
Back
Forward
Up
Cut
Copy
Paste
Undo
Delete
Properties
Views
Address
Control Panel
Links
MarconiLive
Customize Links
Windows
Best of the Web
Channel Guide
Internet Explorer News
Internet Start
Control Panel
Add/Remove Programs
Fonts
Modems
Passwords
Sounds
Date/Time
Game Controllers
Mouse
Power Management
System
Desktop Themes
Internet Options
Multimedia
Printers
Systems Management
Display
Keyboard
Network
Quick Time
Telephony

Figure 13-1: Windows 98 Control Panel

8. Click the Power Schemes Tab in the Power Management Properties Dialog Box.
    a. If not already set, select **Always On** under Power schemes
    b. Select **Never** for all settings in the Settings for Always On power scheme area(*Figure 13-2*). Delete all other schemes.
9. If no changes were necessary, click **Cancel** to dismiss the dialog box. Otherwise, click **Apply** and then **OK** to accept any changes and to dismiss the dialog box.
10. Double-click the **System** icon (*Figure 13-1*) to display the System Properties Dialog Box (*Figure 13-3*).
11. Click the Device Manager tab in the System Properties Dialog Box to view the list of devices (*Figure 13-3*).
12. Double-click the **System devices** icon to display the list of System devices (*Figure 13-3*). Delete the Advanced Power Management support device icon (if present).
13. If any changes were made, restart the PC for the changes to take effect. make sure that there is no Advanced Power Management support icon present.



A power scheme is a group of preset power options. Select the power scheme most appropriate for the way you are using your computer.

Power schemes: Always On

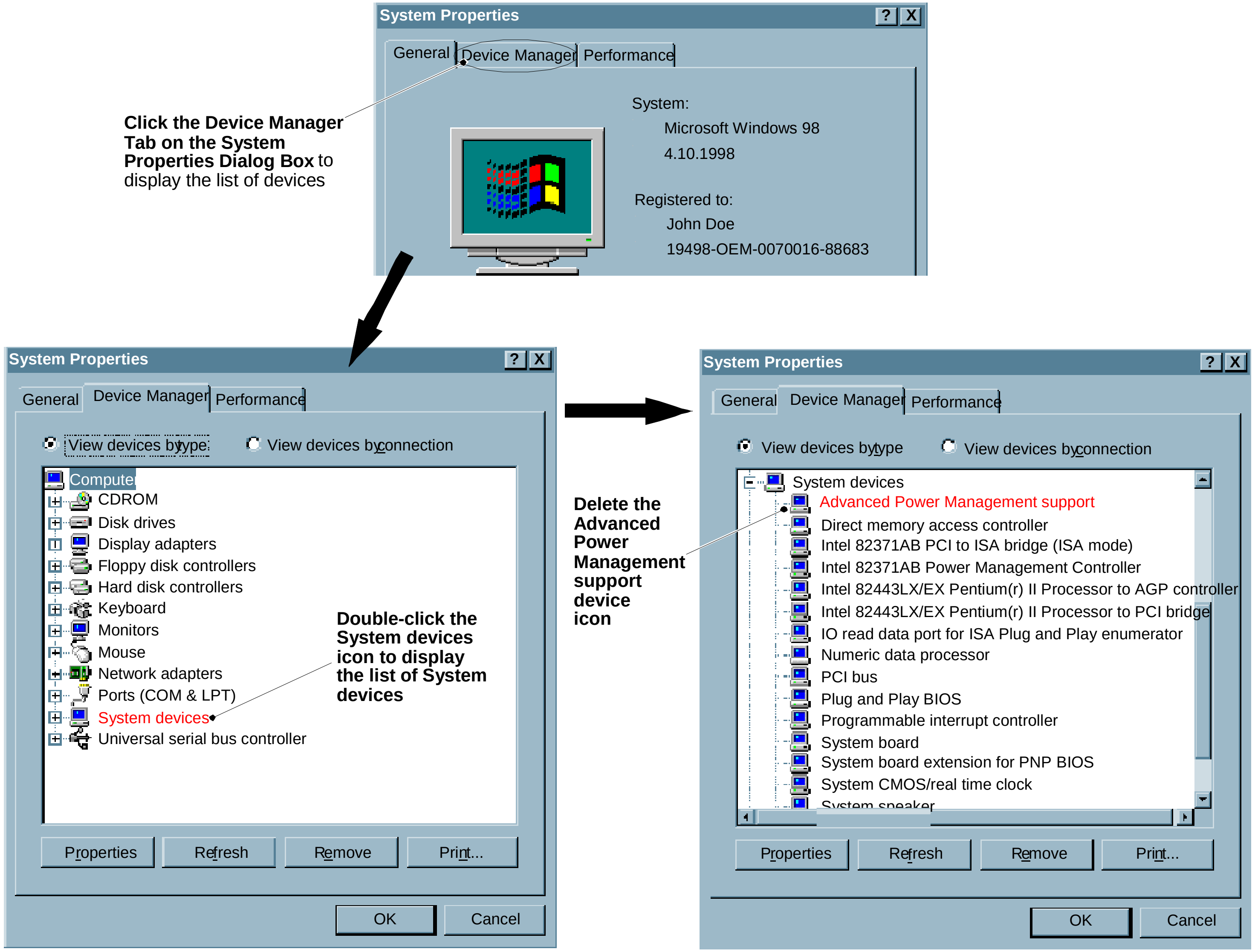
Settings for Always On power scheme

System standby: Never

Turn off monitor: Never

Turn off hard disks: Never

Figure 13-2: Power Management Properties


System Properties
?
X
General
Device Manager
Performance
View devices by type
View devices by connection
Computer
CDROM
Disk drives
Display adapters
Floppy disk controllers
Hard disk controllers
Keyboard
Monitors
Mouse
Network adapters
Ports (COM & LPT)
System devices
Universal serial bus controller
Advanced Power Management support
Direct memory access controller
Intel 82371AB PCI to ISA bridge (ISA mode)
Intel 82371AB Power Management Controller
Intel 82443LX/EX Pentium(r) II Processor to AGP controller
Intel 82443LX/EX Pentium(r) II Processor to PCI bridge
IO read data port for ISA Plug and Play enumerator
Numeric data processor
PCI bus
Plug and Play BIOS
Programmable interrupt controller
System board
System board extension for PNP BIOS
System CMOS/real time clock
System speaker
Properties
Refresh
Remove
Print...
OK
Cancel

System:
Microsoft Windows 98
4.10.1998

Registered to:
John Doe
19498-OEM-0070016-88683

Click the Device Manager Tab on the System Properties Dialog Box to display the list of devices

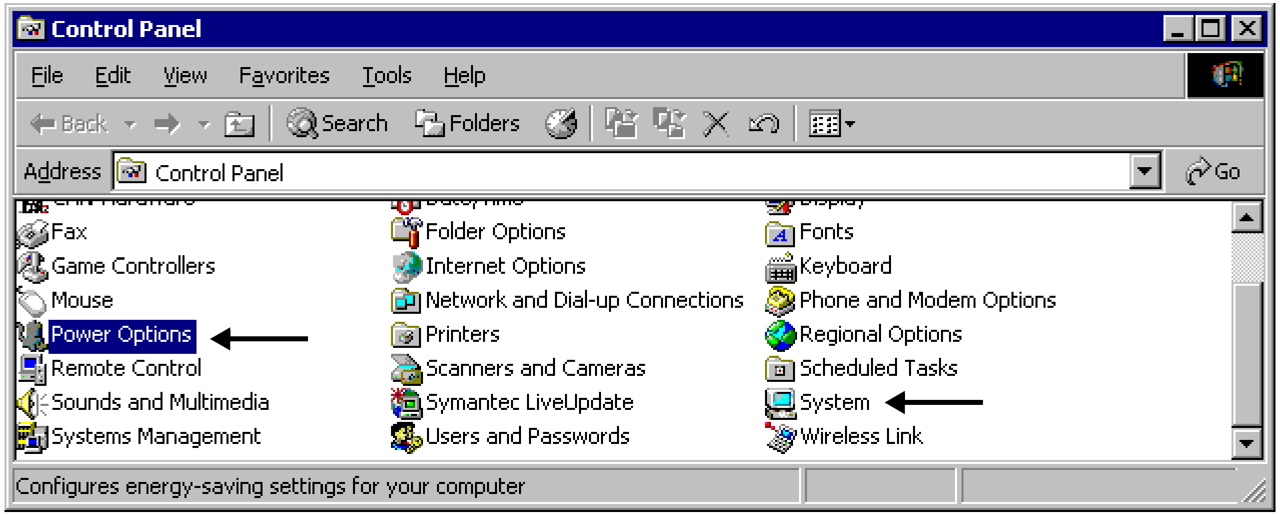
Double-click the System devices icon to display the list of System devices

Delete the Advanced Power Management support device icon

Figure 13-3: System Properties Windows 98

Pre-setup Installation for Windows 2000 Systems

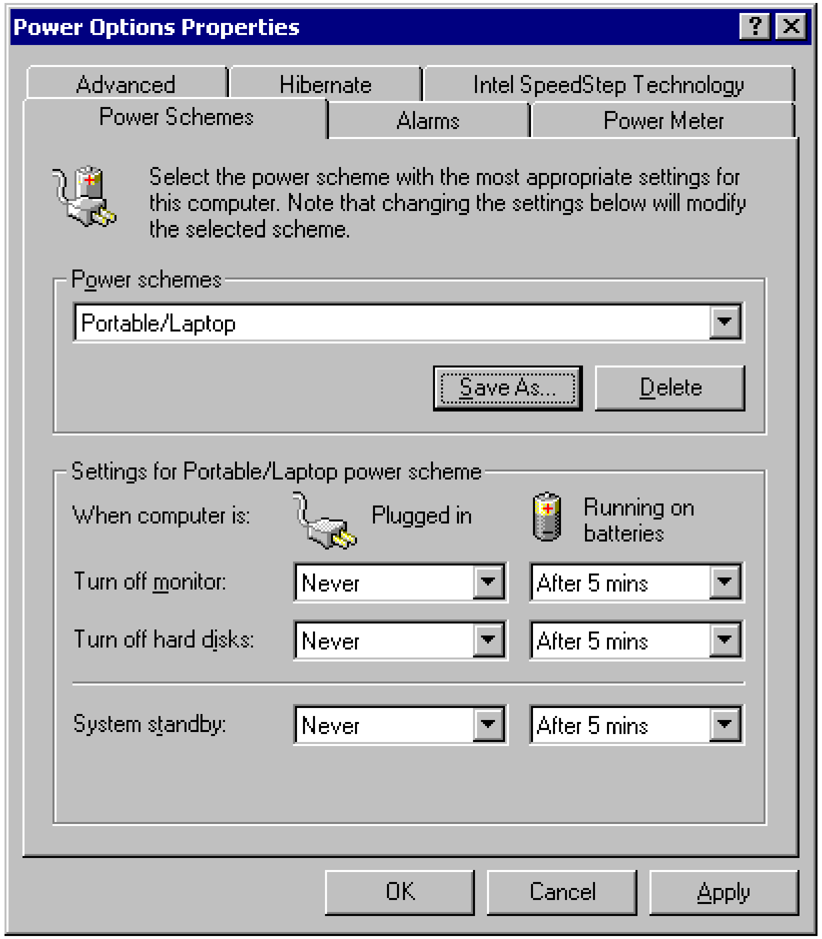
1. Turn on the PC and enter the BIOS/CMOS Setup. These settings may differ in various computers, depending on the BIOS version and CPU.
2. Change the setting (if possible) of any unused IRQ intended for use with the PEAK CAN dongle from **AVAILABLE** to **RESERVED**. Use this IRQ at the point in the installation where hardware for the PEAK CAN device driver is defined. If no conflict exists, the following settings are recommended:
   - — I/O Address: 0378
   - — Interrupt: 07
3. Change all power management settings from **ENABLED** to **DISABLED**.
4. Change the parallel port to EPP mode (or ECP if EPP is unavailable).
5. Save changes and exit the BIOS/CMOS Setup while allowing the PC to restart.
6. On the **Start** menu, click **Settings** and then click **Control Panel**.
7. Double-click the Power Options icon (*Figure 13-4*).


Control Panel
File
Edit
View
Favorites
Tools
Help
Back
Search
Folders
Address
Control Panel
Go
Fax
Game Controllers
Mouse
Power Options
Remote Control
Sounds and Multimedia
Systems Management
Folder Options
Internet Options
Network and Dial-up Connections
Printers
Scanners and Cameras
Symantec LiveUpdate
Users and Passwords
Fonts
Keyboard
Phone and Modem Options
Regional Options
Scheduled Tasks
System
Wireless Link

Configures energy-saving settings for your computer

Figure 13-4: Windows 2000 Control Panel

8. Click the Power Schemes tab on the Power Options Properties dialog box (see *Figure 13-5*). In the Setting for Portable/Laptop power scheme area, select **Never** for all settings under **Plugged in**.
   Do not run the CANpro with batteries as a power source.
9. If no changes are necessary, click **Cancel** to close the dialog box. Otherwise, click **Apply** and then **OK** to accept any changes and to close the dialog box.
10. In the **Control Panel**, double click the **System** icon (*Figure 13-4*) to display the System Properties Dialog box (*Figure 13-6*).


Power Options Properties
?
Advanced
Hibernate
Intel SpeedStep Technology
Power Schemes
Alarms
Power Meter
Save As...
Delete
OK
Cancel
Apply

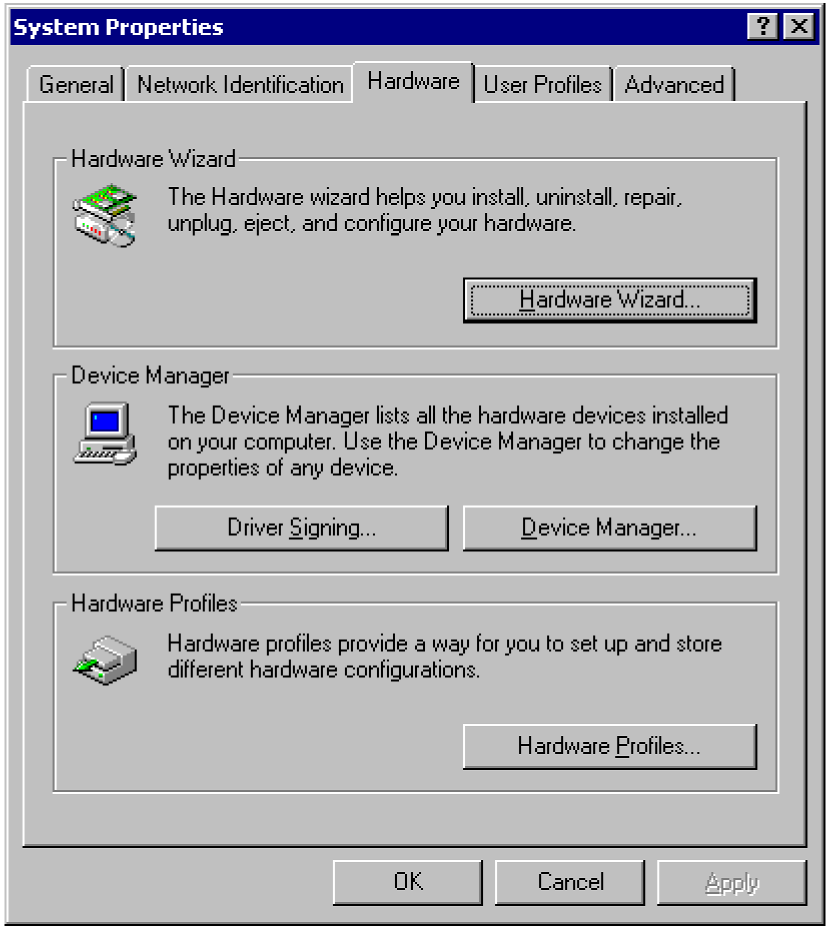
Select the power scheme with the most appropriate settings for this computer. Note that changing the settings below will modify the selected scheme.

Power schemes: Portable/Laptop

Settings for Portable/Laptop power scheme

When computer is:	Plugged in	Running on batteries
Turn off monitor:	Never	After 5 mins
Turn off hard disks:	Never	After 5 mins
System standby:	Never	After 5 mins

Figure 13-5: Power Options Properties


System Properties
?
General
Network Identification
Hardware
User Profiles
Advanced
Hardware Wizard
Hardware Wizard...
Device Manager
Driver Signing...
Device Manager...
Hardware Profiles
Hardware Profiles...
OK
Cancel
Apply

The Hardware wizard helps you install, uninstall, repair, unplug, eject, and configure your hardware.

The Device Manager lists all the hardware devices installed on your computer. Use the Device Manager to change the properties of any device.

Hardware profiles provide a way for you to set up and store different hardware configurations.

Figure 13-6: System Properties

11. Select the **Hardware** tab of the System Properties dialog box and click **Device Manager** to view the list of devices (*Figure 13-6*).
12. Double click the Printer port (LPT1) icon (*Figure 13-7*) to open the Printer Port Properties dialog box.

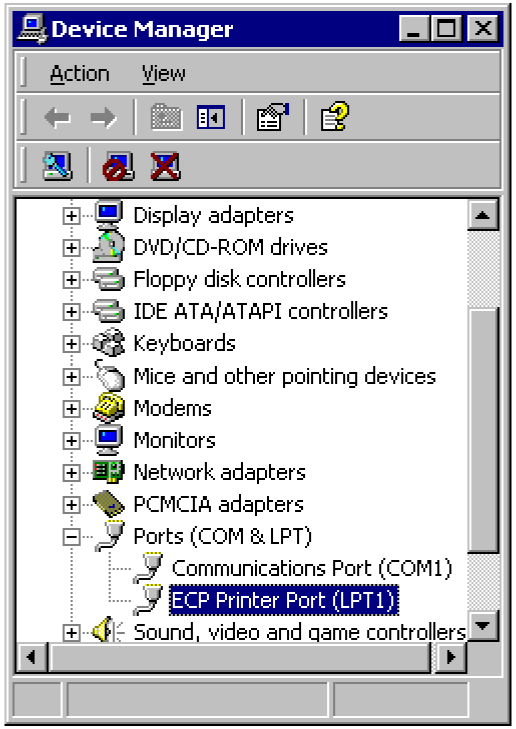
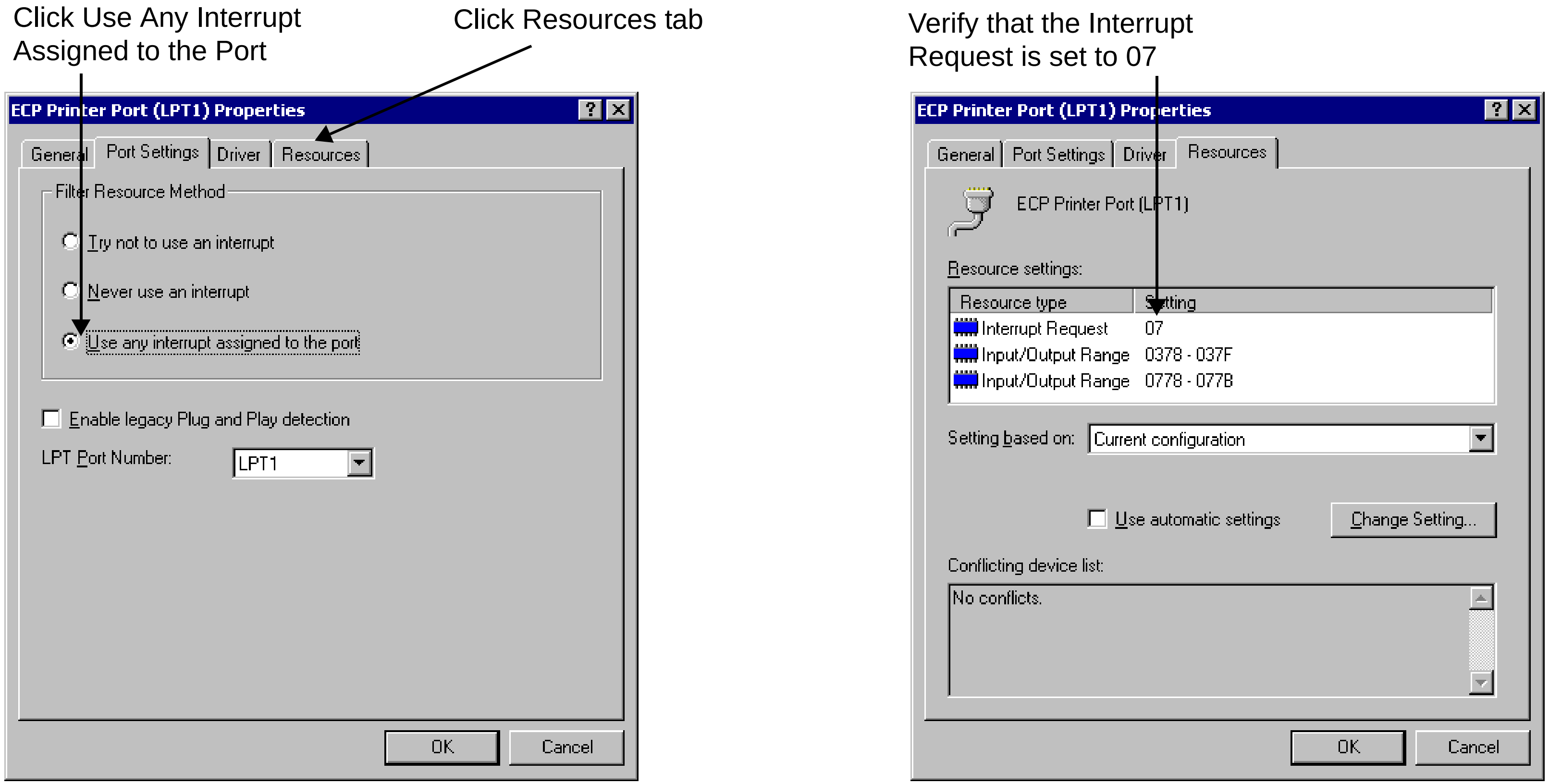

Device Manager
Action
View
Display adapters
DVD/CD-ROM drives
Floppy disk controllers
IDE ATA/ATAPI controllers
Keyboards
Mice and other pointing devices
Modems
Monitors
Network adapters
PCMCIA adapters
Ports (COM & LPT)
Communications Port (COM1)
ECP Printer Port (LPT1)
Sound, video and game controllers

Figure 13-7: Device Manager Window

13. In the Port Settings tab, click **Use any interrupt assigned to the port**.
14. In the Resources tab, verify that the current configuration is set as shown in *Figure 13-8*. If not, clear the **Use automatic settings** check box (*Figure 13-9*), to enable the **Change Setting** button.


Click Use Any Interrupt Assigned to the Port

Click Resources tab

Verify that the Interrupt Request is set to 07

ECP Printer Port (LPT1) Properties

Filter Resource Method

○ Try not to use an interrupt

○ Never use an interrupt

● Use any interrupt assigned to the port

☐ Enable legacy Plug and Play detection

LPT Port Number: LPT1

ECP Printer Port (LPT1) Properties

ECP Printer Port (LPT1)

Resource settings:

Resource type	Setting
Interrupt Request	07
Input/Output Range	0378 - 037F
Input/Output Range	0778 - 077B

Setting based on: Current configuration

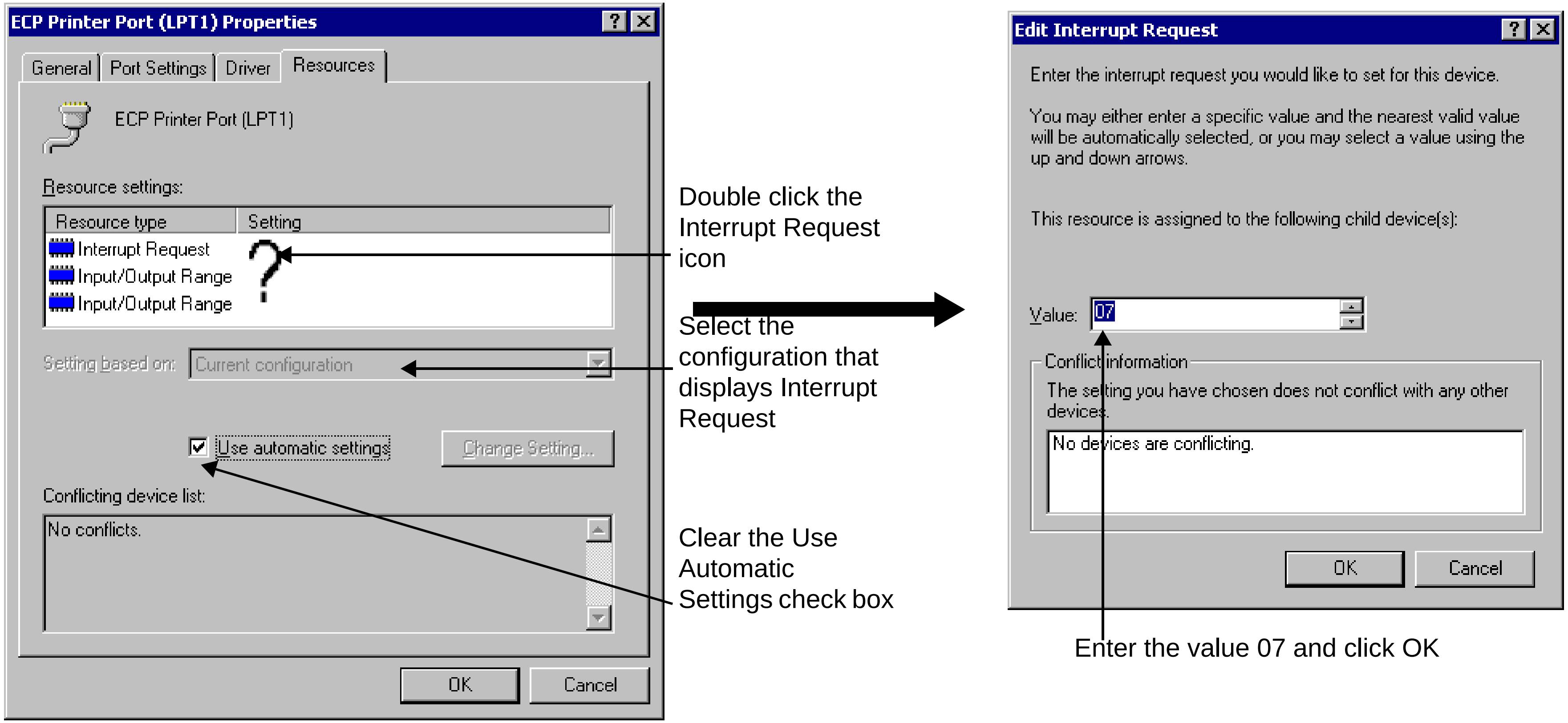
☐ Use automatic settings

Conflicting device list:

No conflicts.

Figure 13-8: Printer Properties Dialog Box

15. Select a configuration that enables the selection of an Interrupt Request, and an I/O Range that complies with the requirements in Step 2 above.
16. In the Resource Settings tab, double-click the **Interrupt Request** icon. The Edit Interrupt Request dialog box appears.
17. In the Value text box, enter the value recommended in Step 2 and click **OK**.
18. In the General tab of the Printer Port Properties dialog box, verify that no conflicts are present.
19. Click **OK**, and restart the computer.



ECP Printer Port (LPT1)

Resource settings:

Resource type	Setting
Interrupt Request	?
Input/Output Range	
Input/Output Range	

Setting based on: Current configuration

☑ Use automatic settings

Conflicting device list:

No conflicts.

Enter the interrupt request you would like to set for this device.

You may either enter a specific value and the nearest valid value will be automatically selected, or you may select a value using the up and down arrows.

This resource is assigned to the following child device(s):

Value: 07

Conflict information

The setting you have chosen does not conflict with any other devices.

No devices are conflicting.

Double click the Interrupt Request icon

Select the configuration that displays Interrupt Request

Clear the Use Automatic Settings check box

Enter the value 07 and click OK

Figure 13-9: Interrupt Setup

Installing CANpro Can Test Tool Software

Two steps are required to install CANpro Test tool on a PC. They are:

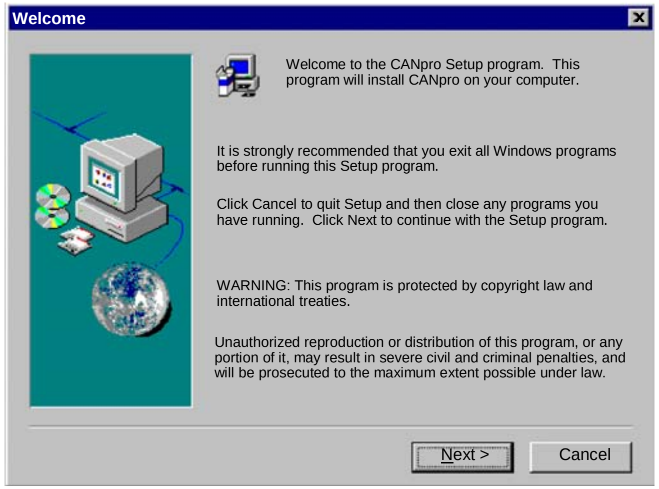
- Installation of CANpro, its device drivers and a machine description
- Definition of hardware for the CAN driver

Install CAnpro, Device Drivers & Machine Description

> **NOTE:**
>
> Any version of CANpro older than version 6.15 must be completely uninstalled from the computer. Refer to the section in this instruction entitled *“Uninstalling CANpro Secure 4.8 Diagnostic Software”* for details.

1. Close all applications.
2. Insert the **CANpro Version 8.1** CD-ROM into the CD-ROM drive. Setup starts automatically.

> **NOTE:**
>
> Double click **Setup.exe** in the CD’s root directory with Windows Explorer if the PC’s Autorun feature is disabled.



Welcome to the CANpro Setup program. This program will install CANpro on your computer.

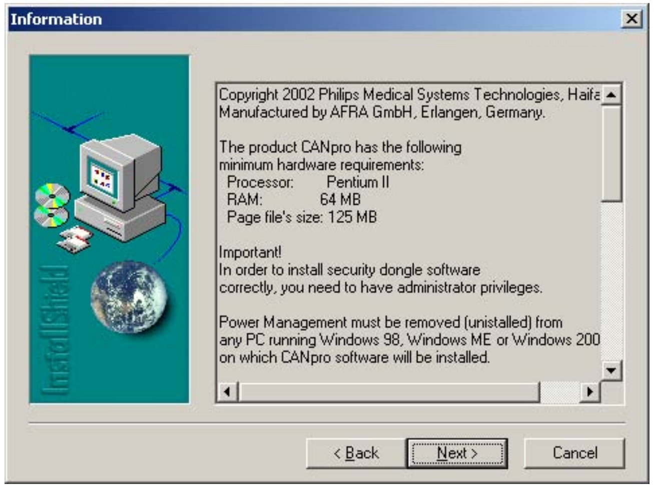
It is strongly recommended that you exit all Windows programs before running this Setup program.

Click Cancel to quit Setup and then close any programs you have running. Click Next to continue with the Setup program.

WARNING: This program is protected by copyright law and international treaties.

Unauthorized reproduction or distribution of this program, or any portion of it, may result in severe civil and criminal penalties, and will be prosecuted to the maximum extent possible under law.

Figure 13-10: Welcome Dialog Box



Copyright 2002 Philips Medical Systems Technologies, Haifa
Manufactured by AFRA GmbH, Erlangen, Germany.

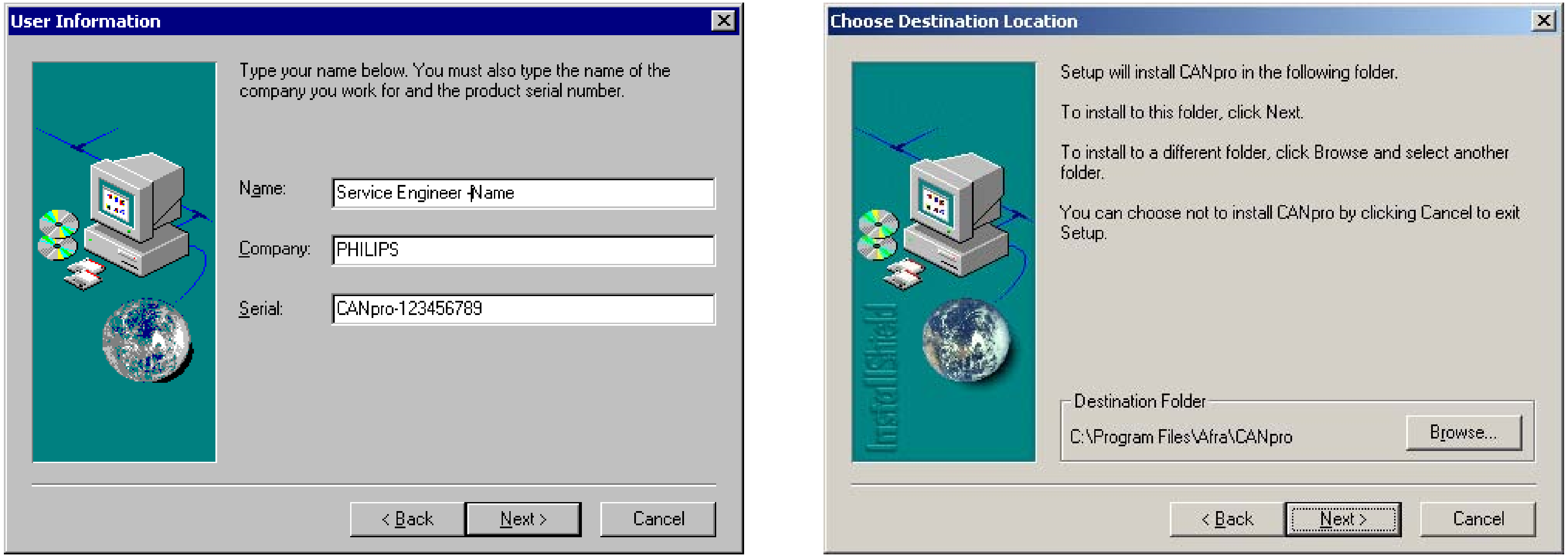
The product CANpro has the following
minimum hardware requirements:
Processor: Pentium II
RAM: 64 MB
Page file's size: 125 MB

Important!
In order to install security dongle software
correctly, you need to have administrator privileges.

Power Management must be removed (unistalled) from
any PC running Windows 98, Windows ME or Windows 200
on which CANpro software will be installed.

Figure 13-11: Information Dialog Box

3. Click **Next** after the Welcome dialog box is displayed (see *Figure 13-10*).
4. Click **Next** after the Information dialog box is displayed (*Figure 13-11*). The Information dialog box displays information about CAN hardware supported by the PEAK PCAN driver and about CANpro itself.
5. Setup reads your user and company names from the registry and inserts the corresponding edit fields in the User Information dialog box *Figure 13-12*). The edit fields can be changed to anything you want. A dummy serial number is already displayed in the corresponding field as well.



User Information

Type your name below. You must also type the name of the company you work for and the product serial number.

Name: Service Engineer Name

Company: PHILIPS

Serial: CANpro-123456789

Choose Destination Location

Setup will install CANpro in the following folder.

To install to this folder, click Next.

To install to a different folder, click Browse and select another folder.

You can choose not to install CANpro by clicking Cancel to exit Setup.

Destination Folder

C:\Program Files\Afra\CANpro

Figure 13-12: User Information and Choose Destination Location Dialog Boxes

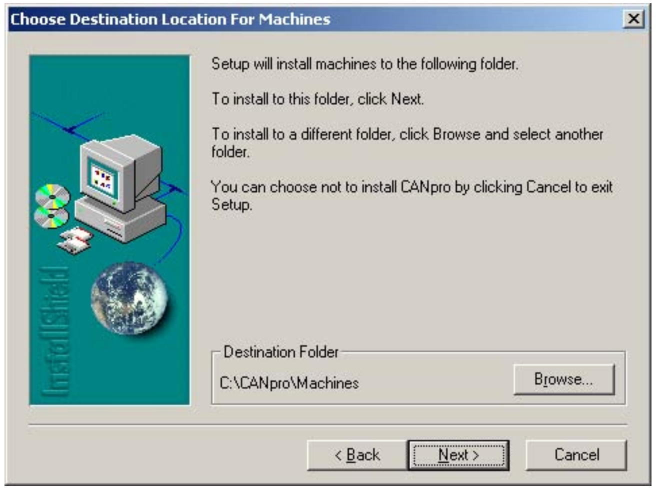
6. Make any desired changes in the User Information dialog box and click **Next**.
7. Use the Choose Destination Location Dialog box (*Figure 13-12*) to select the CANpro installation path. The default path is C:\Program Files\Afra\CANpro, which can be changed according to your needs. The Setup program informs you whether there is enough space at the given location. If not, you can return to this dialog box and change the setting.
8. Edit the path if desired and click **Next**.

9. Use the Choose Destination Location for Machines Dialog Box (*Figure 13-13*) to select the path for the "machines" folder. The default path is C:\CANpro\Machines (recommended).

NOTE:

Test results are also stored in the machines folder.

10. Edit the path if desired.
11. Click **Next** to accept the path and proceed to the Select Components Dialog Box (*Figure 13-14*).


Choose Destination Location For Machines
InstallShield
Destination Folder
Browse...
< Back
Next >
Cancel

Setup will install machines to the following folder.

To install to this folder, click Next.

To install to a different folder, click Browse and select another folder.

You can choose not to install CANpro by clicking Cancel to exit Setup.

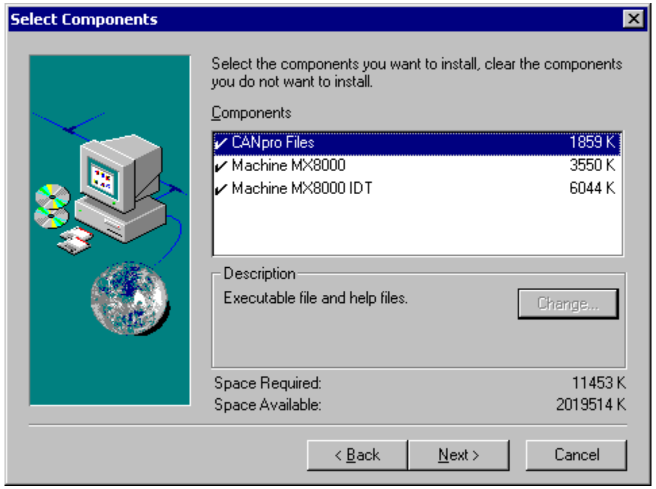
C:\CANpro\Machines

Figure 13-13: Path for Machine Folder Dialog Box

NOTE:

The Select Components dialog box is used for the initial installation of CANpro and also when updating CANpro to a newer software revision.

12. The CANpro Files component must be checked when installing CANpro. Setup does not allow the installation to continue if this component is not selected.
13. Select at least one machine description. It is recommended to select the default for all components.


Select Components
Components
Description
Change...
< Back
Next >
Cancel

Select the components you want to install, clear the components you do not want to install.

✓ CANpro Files	1859 K
✓ Machine MX8000	3550 K
✓ Machine MX8000 IDT	6044 K

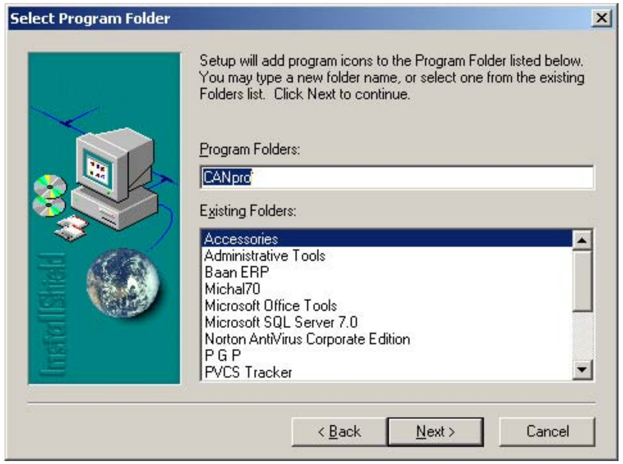
Executable file and help files.

Space Required:	11453 K
Space Available:	2019514 K

Figure 13-14: Select Components Dialog Box

14. Click **Next** to proceed to the Select Program Folder Dialog Box (*Figure 13-15*).

> **NOTE:**
>
> The default program folder name is CANpro.



Setup will add program icons to the Program Folder listed below. You may type a new folder name, or select one from the existing Folders list. Click Next to continue.

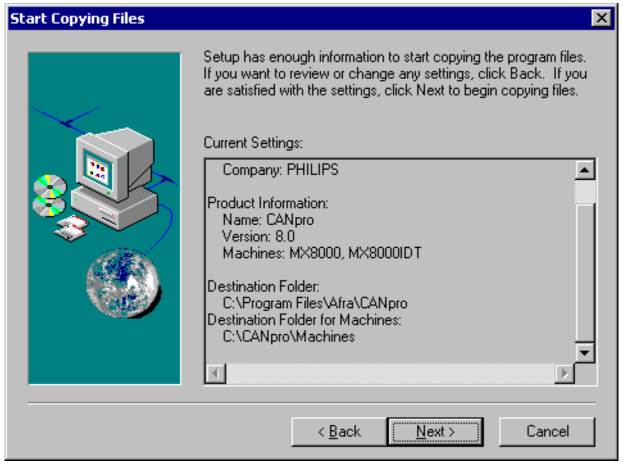
Program Folders:
CANpro

Existing Folders:
Accessories
Administrative Tools
Baan ERP
Michal70
Microsoft Office Tools
Microsoft SQL Server 7.0
Norton AntiVirus Corporate Edition
P G P
PVCS Tracker

Figure 13-15: Select Program Files Dialog Box

15. Determine the program folder name that you want to appear in the start menu in the Programs list. CANpro may be added to any existing folder. Click **Next**.

> **NOTE:**
>
> The Setup program now has all the information required to begin installing CANpro on your computer. A dialog box entitled Start Copying Files contains a short summary as shown in (*Figure 13-16*).



Setup has enough information to start copying the program files. If you want to review or change any settings, click Back. If you are satisfied with the settings, click Next to begin copying files.

Current Settings:
Company: PHILIPS

Product Information:
Name: CANpro
Version: 8.0
Machines: MX8000, MX8000IDT

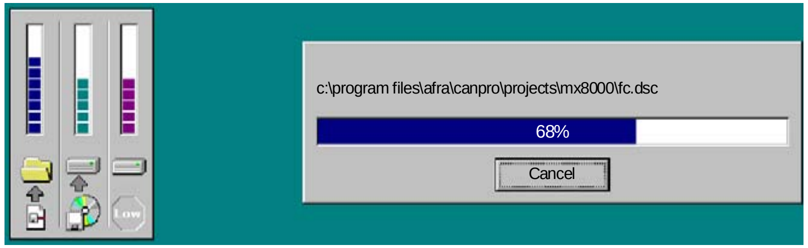
Destination Folder:
C:\Program Files\Afra\CANpro
Destination Folder for Machines:
C:\CANpro\Machines

Figure 13-16: Start Copying Files Dialog Box

16. Click **Next** to accept the settings or click **Back** if you want to make any changes.

> NOTE:
>
> Having selected **Next** in the Start Copying Files Dialog Box (*Figure 13-17*), a progress indicator appears to graphically display files being copied to your computer (*Figure 13-17*). The Setup Complete dialog box (*Figure 13-18*) informs you that the installation was successful and that you must reboot the PC.

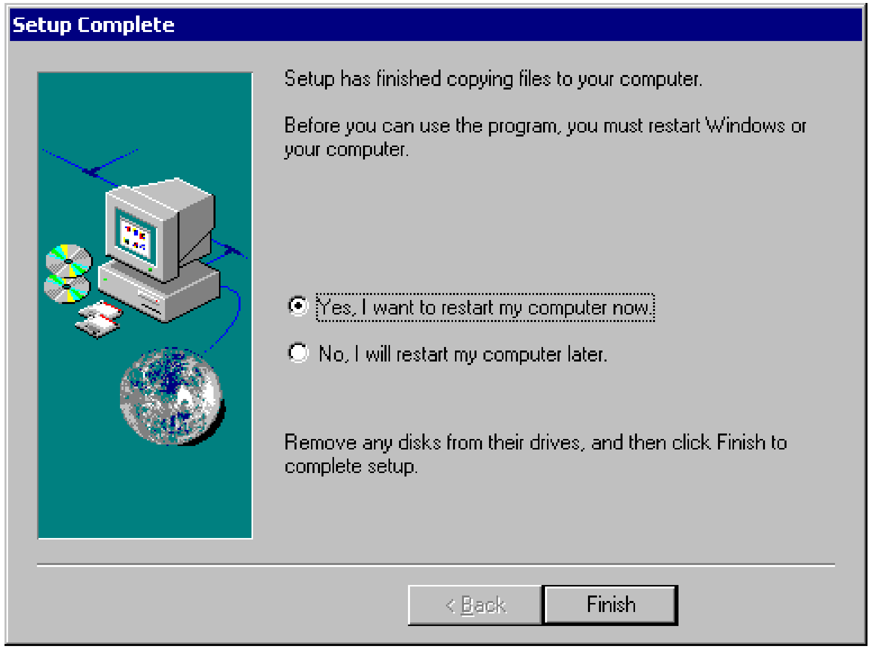
17. Check **Yes I want to restart my computer now** and click **Finish**.



c:\program files\afra\canpro\projects\mx8000\fc.dsc

68%

Figure 13-17: Copying Files Progress Bar



Setup Complete

Setup has finished copying files to your computer.

Before you can use the program, you must restart Windows or your computer.

● Yes, I want to restart my computer now.

○ No, I will restart my computer later.

Remove any disks from their drives, and then click Finish to complete setup.

Figure 13-18: Setup Complete Dialog Box

Define Hardware for the Peak Can Device Driver

CAUTION

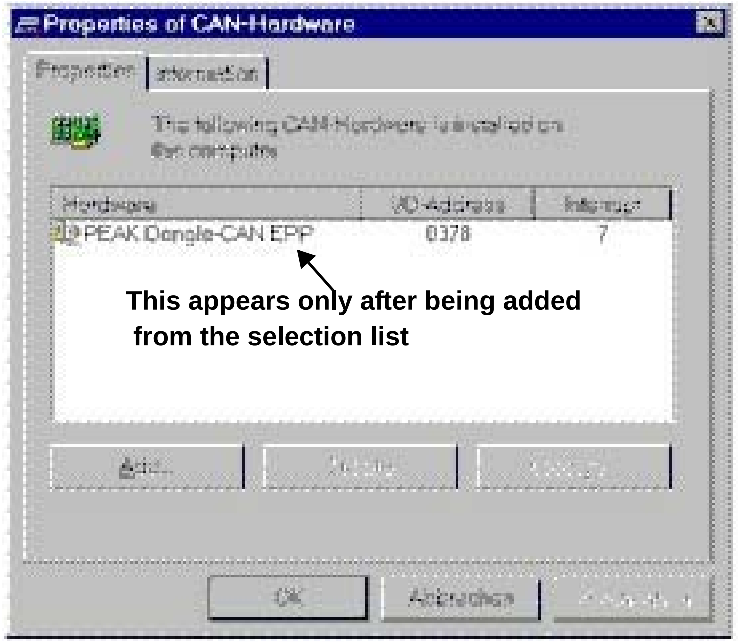
NEVER ATTACH OR REMOVE THE PEAK CAN DONGLE WHILE THE POWER IS ON.

1. Shutdown the PC and attach the Peak CAN dongle to the Security dongle. Then attach the two-dongle assembly to the parallel port chosen in Step 2 of Pre-setup Installation. The security dongle is not needed with K2000 enabled.
2. Reboot, open the system Control Panel, and double-click

   CAN Hardware CAN-Hardware .

NOTE:

If this is the first installation, *Figure 13-19* opens with a blank screen.



Properties of CAN-Hardware

The following CAN-Hardware is installed on the computer:

Hardware	I/O-Address	Interrupt
PEAK Dongle-CAN EPP	0378	7

This appears only after being added from the selection list

Figure 13-19: Properties of CAN Hardware

3. Click **Add** and select the PEAK Dongle-CAN EPP device driver. If the driver is already listed, proceed to step 5 below.

4. Enter the I/O Address and Interrupt request for the parallel port that was recommended in Step 2 of Pre-setup Installation and shown in Figure 17.
5. Click **Apply** to accept the changes and **OK** to close the CAN-Hardware properties dialog box. Device properties can be changed later if required.

⚠ CAUTION

The device installed first is listed first. The first device on the list is always the default device.

Ethernet Setup

Introduction

Two physical connections must be made for the CANpro CAN Test Tool to work properly:

- Using a RS-232 cable from the scanner's MCU X5 to the Peak-CAN dongle attached to your laptop's parallel port. This connection allows monitoring of the scanner's CAN bus.
- Using an Ethernet cable (RJ-45) connected from your laptop's network card to a jack on the hospital's network. This connection allows the host computer to transfer information about the scanner to the laptop.

Changes to the laptop's network settings are required if CANpro software is to communicate with the host computer via the Ethernet connection. Since the network setup may vary from one hospital to another, it follows that there is more than one way to setup the laptop. If the network supports DHCP, you may set the laptop to obtain an IP address automatically and the procedure is complete. If the hospital does not support DHCP, or the network administrator prefers to issue fixed IP addresses, you will have to manually enter the information. The procedure for entering a fixed IP address must be performed each time you want to connect to a scanner located on a different network.

NOTE:

It is recommended that you request a dedicated (fixed) IP address for the CANpro PC whether or not the hospital's network supports DHCP (automatic IP addressing). Ultimately, the hospital's network administrator will decide how you are to set up the laptop.

If a network is not available:

- Connect as a local network point-to-point with a twisted cable between the laptop and the CT machine.
- If an MxView is present, use its IP address to connect the laptop to the CT machine. Remember to reconnect the MxView at the end of the procedure.

The following information is required from the hospital's Network Administrator when manually entering your laptop's network setup:

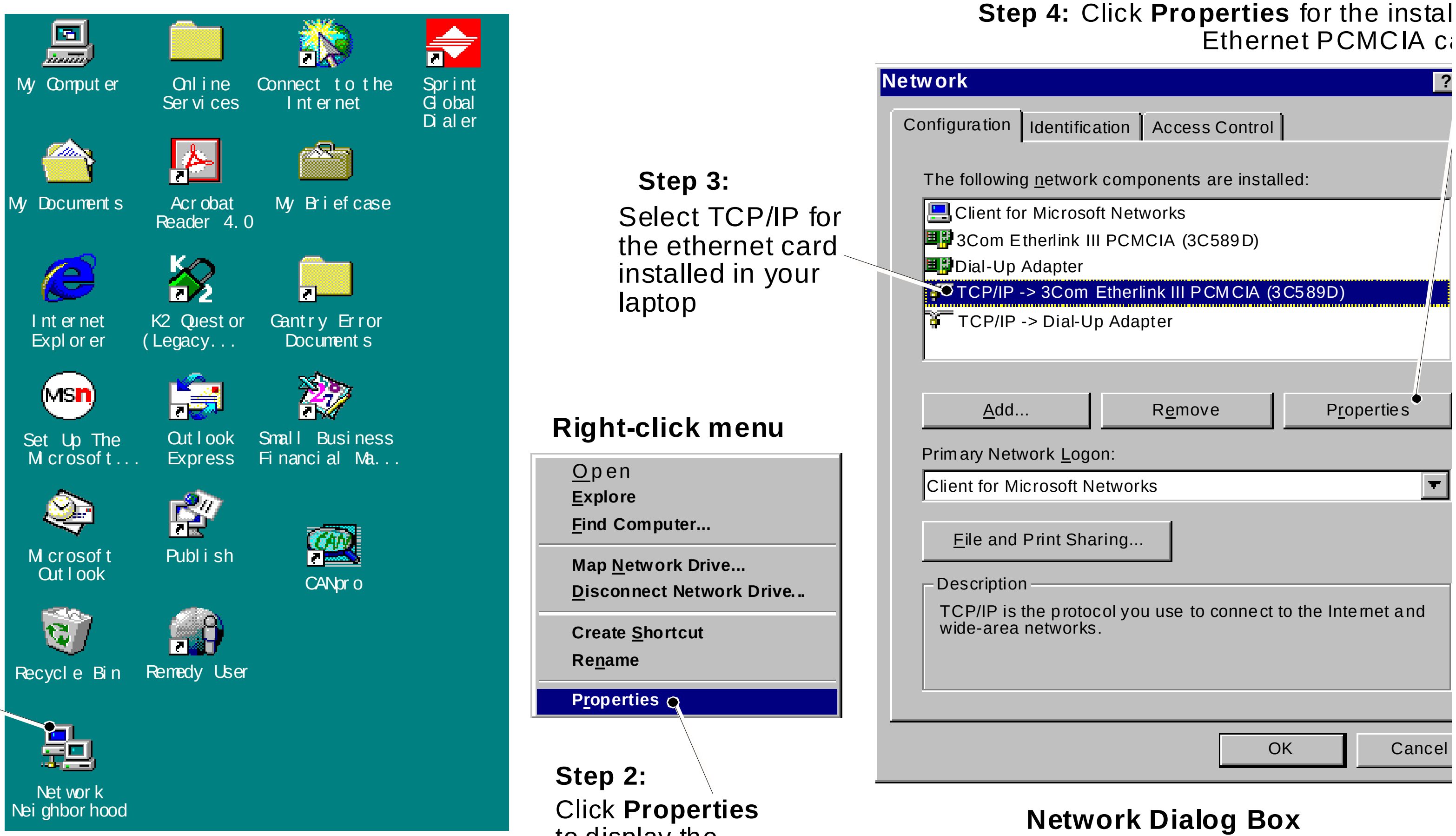
- IP Address for the laptop
- Subnet Mask for the laptop
- IP address of a gateway router (necessary if the laptop is not connected to the same subnet as the scanner)

You also need the IP address of the scanner when running CANpro. When you run the program and type in a new machine description, you are asked for the scanner's IP address. The scanner's IP address only needs to be entered once.

You must create a separate description for each machine that you maintain.

Procedure

The procedure following *Figure 13-20* and *Figure 13-21* assumes your PC is on and running normally.


My Computer
Online Services
Connect to the Internet
Sprint Global Dialer
My Documents
Acrobat Reader 4.0
My Briefcase
Internet Explorer
K2 Questor (Legacy...
Gantry Error Documents
Set Up The Microsoft...
Outlook Express
Small Business Financial Ma...
Microsoft Outlook
Publish
CANpro
Recycle Bin
Remedy User
Network Neighborhood
Open
Explore
Find Computer...
Map Network Drive...
Disconnect Network Drive...
Create Shortcut
Rename
Properties
Network
?
Configuration
Identification
Access Control
Add...
Remove
Properties
File and Print Sharing...
OK
Cancel

Step 1: Right-click Network Neighborhood to display the mouse menu

Typical laptop desktop

Right-click menu

Step 2: Click **Properties** to display the Network dialog box

Step 3: Select TCP/IP for the ethernet card installed in your laptop

Step 4: Click **Properties** for the instal
Ethernet PCMCIA c

The following network components are installed:

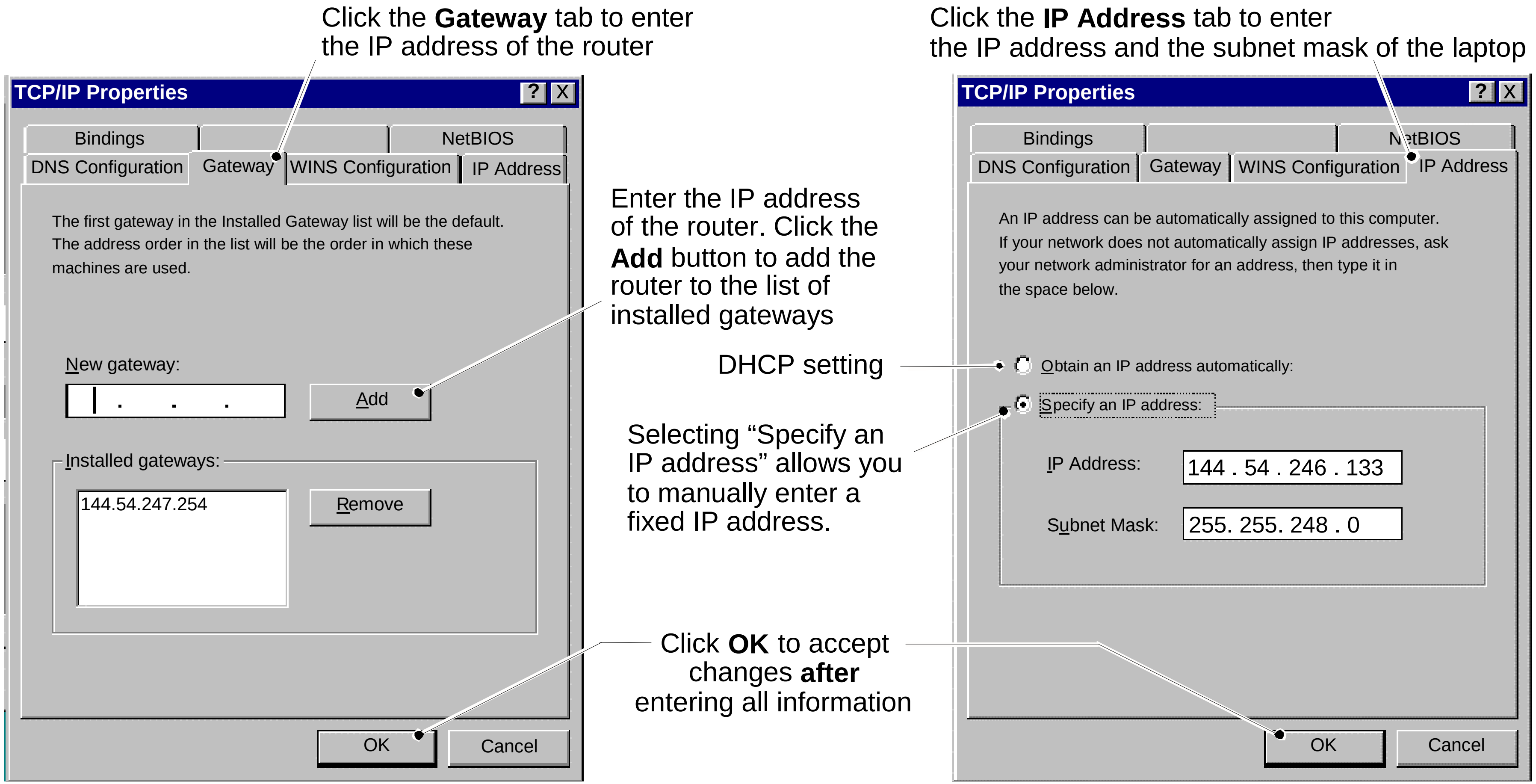
- Client for Microsoft Networks
- 3Com Etherlink III PCMCIA (3C589D)
- Dial-Up Adapter
- TCP/IP -> 3Com Etherlink III PCMCIA (3C589D)
- TCP/IP -> Dial-Up Adapter

Primary Network Logon: Client for Microsoft Networks

Description
TCP/IP is the protocol you use to connect to the Internet and wide-area networks.

Network Dialog Box

Figure 13-20: Network Neighborhood, Right-click Menu and Network Dialog Box


TCP/IP Properties
? X
Bindings
NetBIOS
DNS Configuration
Gateway
WINS Configuration
IP Address
Add
Remove
OK
Cancel
TCP/IP Properties
? X
Bindings
NetBIOS
DNS Configuration
Gateway
WINS Configuration
IP Address
OK
Cancel

Click the **Gateway** tab to enter the IP address of the router

The first gateway in the Installed Gateway list will be the default. The address order in the list will be the order in which these machines are used.

New gateway: . . .

Installed gateways: 144.54.247.254

Enter the IP address of the router. Click the **Add** button to add the router to the list of installed gateways

Click the **IP Address** tab to enter the IP address and the subnet mask of the laptop

An IP address can be automatically assigned to this computer. If your network does not automatically assign IP addresses, ask your network administrator for an address, then type it in the space below.

DHCP setting

○ Obtain an IP address automatically:

● Specify an IP address:

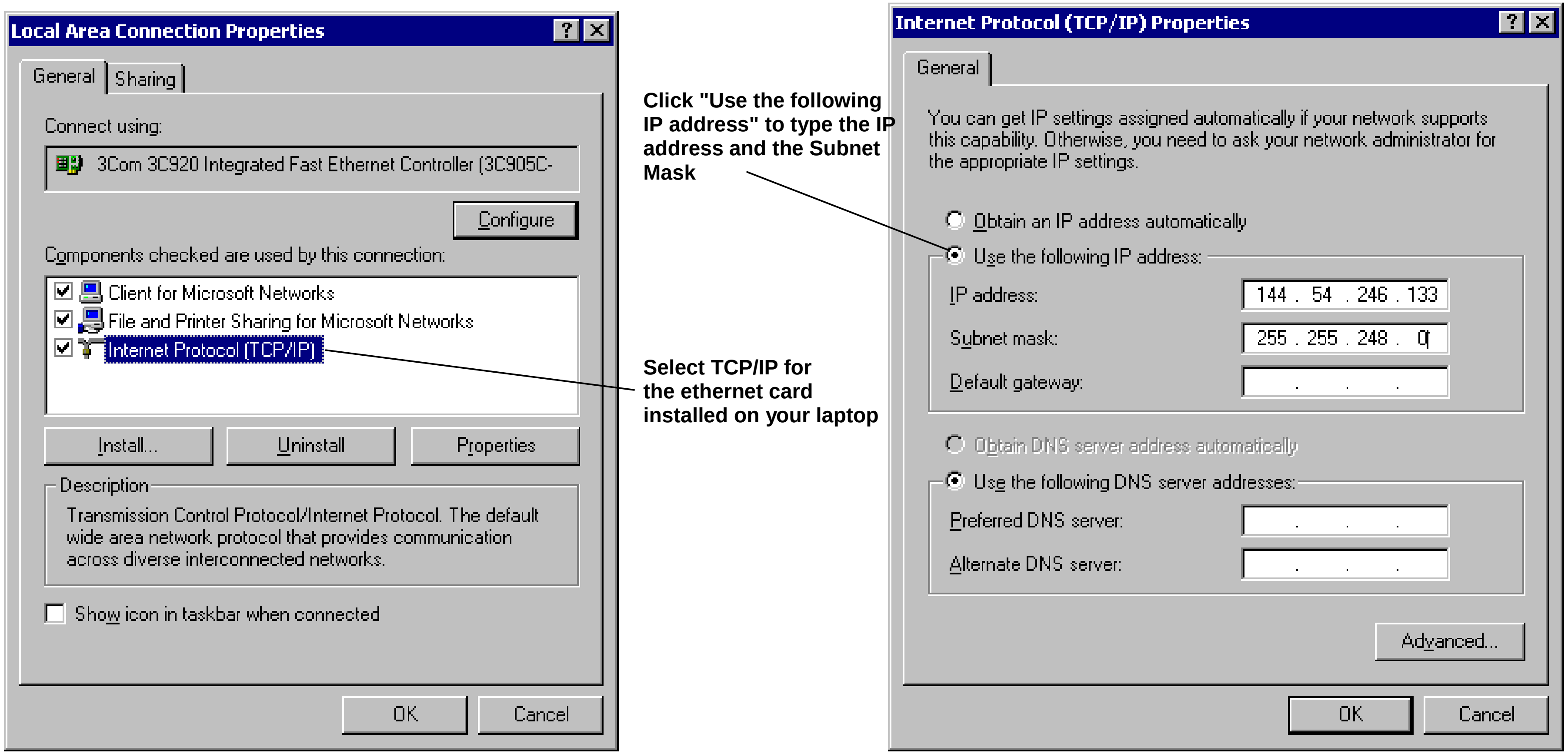
IP Address: 144 . 54 . 246 . 133

Subnet Mask: 255. 255. 248 . 0

Selecting "Specify an IP address" allows you to manually enter a fixed IP address.

Click **OK** to accept changes **after** entering all information

Figure 13-21: Gateway Router and Laptop IP Addresses



Local Area Connection Properties

General | Sharing

Connect using:

3Com 3C920 Integrated Fast Ethernet Controller (3C905C-

Configure

Components checked are used by this connection:

☑ Client for Microsoft Networks
☑ File and Printer Sharing for Microsoft Networks
☑ Internet Protocol (TCP/IP)

Install... | Uninstall | Properties

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

☐ Show icon in taskbar when connected

OK | Cancel

Click "Use the following IP address" to type the IP address and the Subnet Mask

Select TCP/IP for the ethernet card installed on your laptop

Internet Protocol (TCP/IP) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

○ Obtain an IP address automatically
● Use the following IP address:

IP address: 144 . 54 . 246 . 133
Subnet mask: 255 . 255 . 248 . 0
Default gateway: . . .

○ Obtain DNS server address automatically
● Use the following DNS server addresses:

Preferred DNS server: . . .
Alternate DNS server: . . .

Advanced...

OK | Cancel

Figure 13-22: Gateway Router and Laptop IP Addresses for Windows 2000

1. Right-click the **Network Neighborhood** Icon.
2. Select **Properties** from the shortcut menu.
3. Click the TCP/IP network component associated with your laptop’s network card and then click the properties button.

4. Click the IP Address tab at the top of the TCP/IP Properties Window and select one of the following two options:
   a. Obtain an IP address automatically – if you select this option, you simply have to reboot the PC and skip the rest of the Ethernet Setup procedure.
   b. Specify an IP address – select this alternative to continue on with the Ethernet Setup procedure.
5. Enter the IP address and Subnet Mask issued to you by the hospital's Network Administrator. Do not click **OK** yet.
6. Click the Gateway Tab at the top of the TCP/IP Properties Window and enter the gateway router's IP address in the New gateway edit field.
7. Click **Add**. The IP address you just entered appears in the Installed gateways field.
8. Click **OK** at the bottom of the TCP/IP Properties Window to accept all changes and to dismiss the window.
9. Click **OK** at the bottom of the Network window and allow the machine to restart. This completes the Ethernet Setup. Continue on to *"Network Verification"*.

Network Verification

Perform the following procedure to test functioning communication between the laptop and the scanner.

Initial Conditions

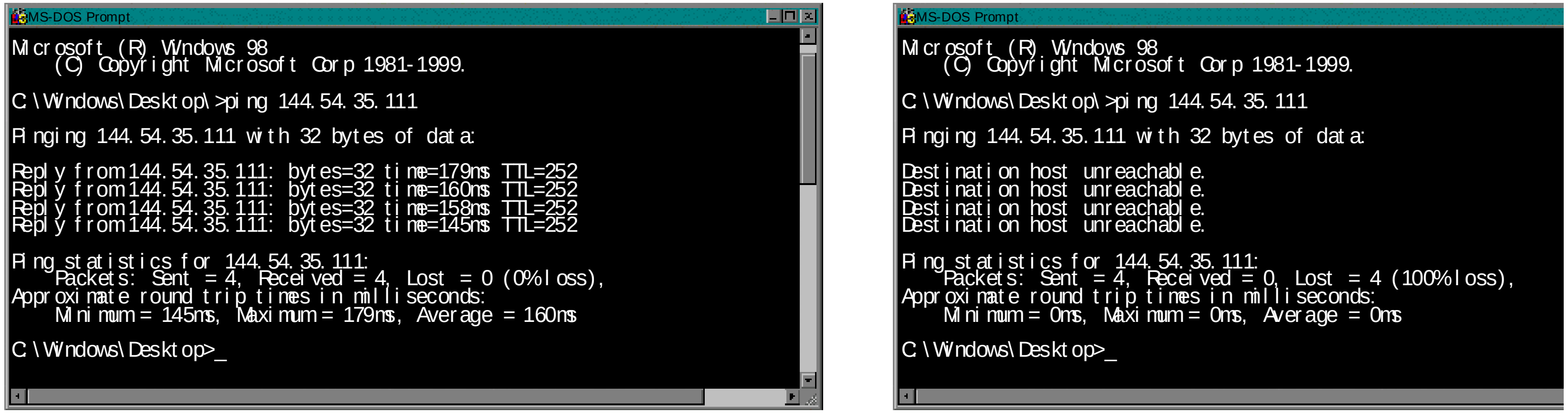
- The Ethernet cable is connected from the laptop’s network card to the hospital’s network
- The Mx8000 / Mx8000 IDT host computer must be booted and connected to the network
- Laptop is booted and running normally

Procedure

1. Open a DOS window by either one of the following two methods:
   a. On the taskbar, click the **Start** button, click **Programs** and then select **MS-DOS Prompt** (Windows 98).
   b. On the taskbar, click the **Start** button, click **Run** and in the text field type: **command**. Click **OK**.
2. Type: **ping <Mx8000 / Mx8000 IDT IP Address>** and press **<Enter>** in the DOS window prompt (see *Figure 13-23*).

NOTE:

<Mx8000 / Mx8000 IDT IP Address> is the numerical IP address of the scanner obtained from the hospital’s Network Administrator.



```
Microsoft (R) Windows 98
    (C) Copyright Microsoft Corp 1981-1999.

C:\Windows\Desktop\>ping 144.54.35.111

Pinging 144.54.35.111 with 32 bytes of data:

Reply from 144.54.35.111: bytes=32 time=179ms TTL=252
Reply from 144.54.35.111: bytes=32 time=160ms TTL=252
Reply from 144.54.35.111: bytes=32 time=158ms TTL=252
Reply from 144.54.35.111: bytes=32 time=145ms TTL=252

Ping statistics for 144.54.35.111:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milliseconds:
    Minimum = 145ms, Maximum = 179ms, Average = 160ms

C:\Windows\Desktop>_
```

Example of a good connection

```
Microsoft (R) Windows 98
    (C) Copyright Microsoft Corp 1981-1999.

C:\Windows\Desktop\>ping 144.54.35.111

Pinging 144.54.35.111 with 32 bytes of data:

Destination host unreachable.
Destination host unreachable.
Destination host unreachable.
Destination host unreachable.

Ping statistics for 144.54.35.111:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
Approximate round trip times in milliseconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\Windows\Desktop>_
```

Example of a bad connection

Figure 13-23: Ping the Mx8000 Scanner

Connecting to the Scanner for the First Time

The operation of CANpro CAN Test Tool is slightly different when connecting to a machine for the first time. Initialization time varies with the size and number of files the host computer downloads to your laptop the first time you connect to the scanner. Once all the information has been downloaded to the laptop initialization time is much shorter.

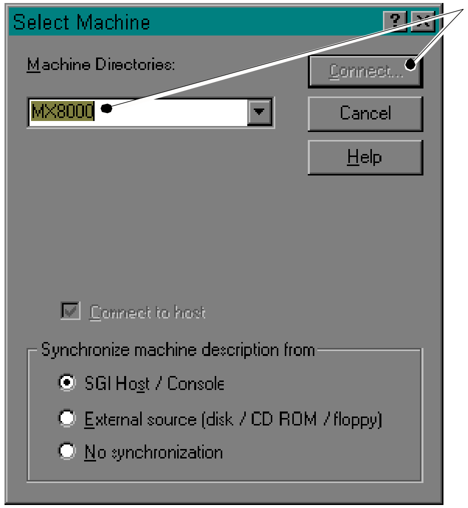
NOTE:

The Mx8000 host computer must be running the application software before connecting to it with CANpro.

For the Mx8000 IDT host computer, log on as **mxservice** (password: **service_only**) before connecting to it with the CANpro (see the CANpro 8.1 Service Instructions for further details).

The desktop shortcut from the previous CANpro program may be used for the new program. After double-clicking the shortcut to the old program, the system searches for and finds the new executable program. Associate the shortcut with the new file.

1. Double-click the CANpro shortcut on the desktop. If no shortcut exists, open Windows Explorer, right-click C:\Program Files\Afra\CANpro\CANpro.exe, select **Send To** and select **Desktop to** create the shortcut.
2. In the Select Machine Dialog box, under Machine Directories, enter a new machine name and click **Connect**. Do not change the default Port setting (see *Figure 13-24*).


Select Machine
?
✕
Machine Directories:
Connect...
Cancel
Help
☑ Connect to host
Synchronize machine description from

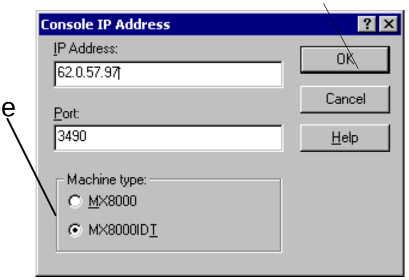
Machine Directories: MX8000

○ SGI Host / Console
○ External source (disk / CD ROM / floppy)
○ No synchronization

Type a new machine name over the default to create a new directory. Then click **connect**.

Type in the IP Address of the machine that you want to connect with. Click **OK.**

Select a machine type

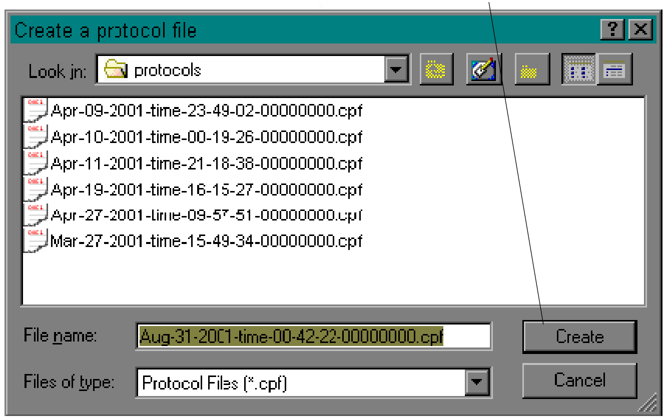

Console IP Address
?
✕
OK
Cancel
Help
Machine type:

IP Address: 62.0.57.97

Port: 3490

○ MX8000
● MX8000IDT

The Create a Protocol Box appears after the initialization period. Type a new name or accept the default name and.click **Create**


Create a protocol file
?
✕
Look in:
protocols
Create
Cancel

Apr-09-2001-time-23-49-02-00000000.cpf
Apr-10-2001-time-00-19-26-00000000.cpf
Apr-11-2001-time-21-18-38-00000000.cpf
Apr-19-2001-time-16-15-27-00000000.cpf
Apr-27-2001-time-09-57-51-00000000.cpf
Mar-27-2001-time-15-49-34-00000000.cpf

File name: Aug-31-2001-time-00-42-22-00000000.cpf

Files of type: Protocol Files (*.cpf)

Figure 13-24: CANpro First Time Operation

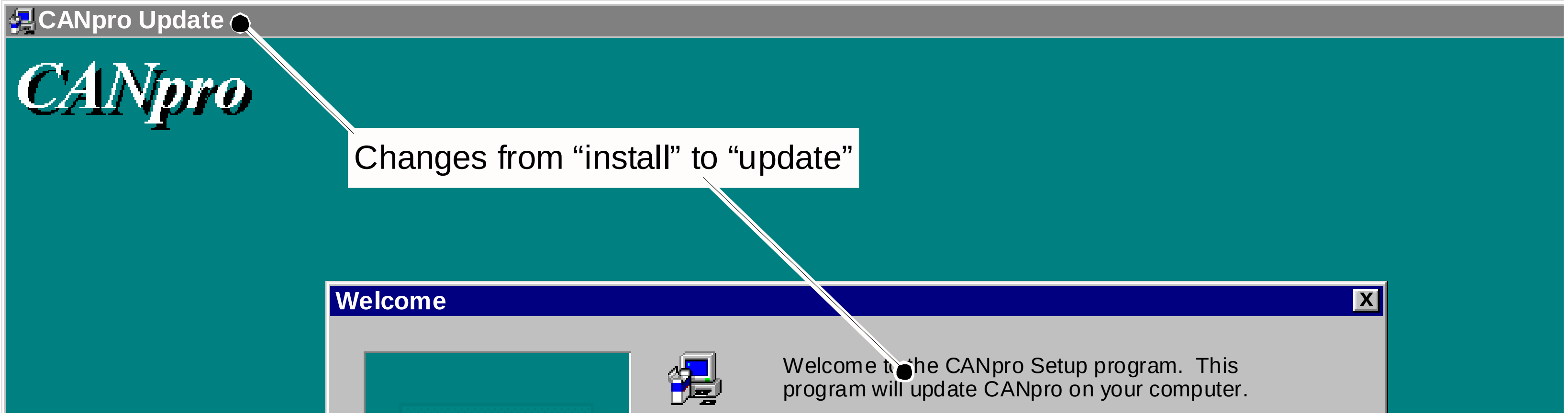
3. Enter the IP address of the machine you are connecting to. CANpro begins downloading files from the host computer to the laptop.
4. When the Create a protocol file dialog box appears, click **Create**. Accept the default file name or change it accordingly.

Updating CANpro

The procedure for updating the 32-bit CANpro application to a newer version takes less time than the initial installation. This is because information required for the update has already been entered and is stored on the PC.

> NOTE:
>
> Any version of CANpro older than version 6.15 must be completely uninstalled from the computer. Refer to the section in this instruction entitled “Uninstalling CANpro 4.8 Software” for details.
> If CANpro version 7.5 is not installed, do not install it prior to installing CANpro 8.1.

1. Insert the CANpro Test Tool Installation CD into the CD drive. Setup starts automatically. If not, double-click **Setup.exe** in Windows Explorer.



Changes from “install” to “update”

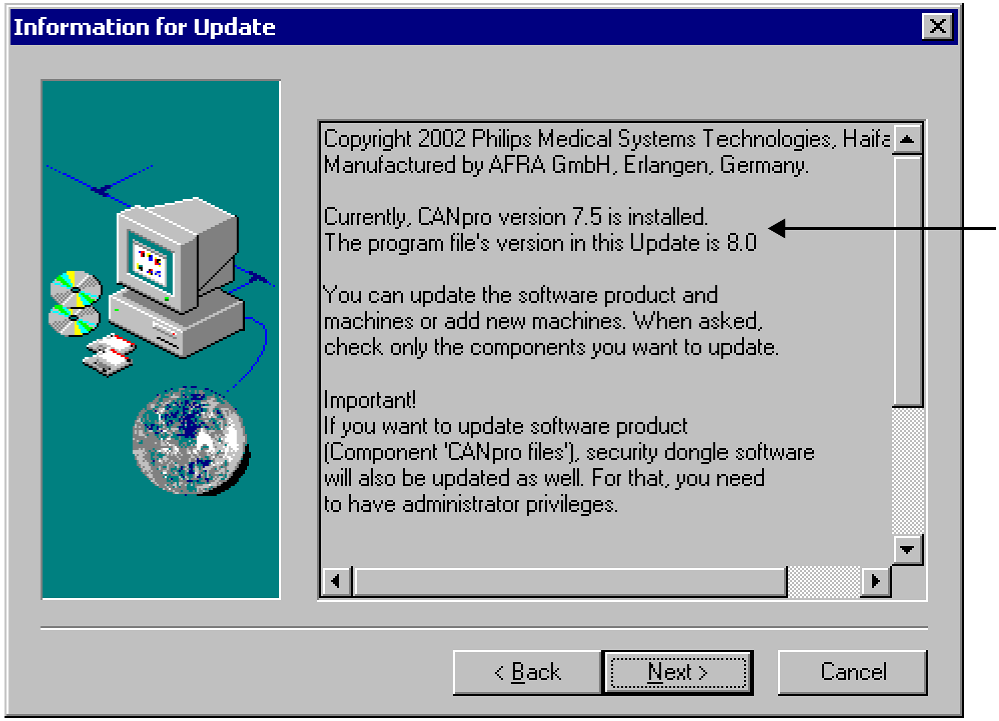
Welcome to the CANpro Setup program. This program will update CANpro on your computer.

Figure 13-25: Updating CANpro First Screen

2. Click **Next**. The Information for Update dialog is displayed.

NOTE:

The Information for Update dialog box displays the currently installed version of CANpro and the one in the current setup/update program so that you can verify that the version of the CANpro in the update pack is newer than the one on your machine.



Copyright 2002 Philips Medical Systems Technologies, Haifa
Manufactured by AFRA GmbH, Erlangen, Germany.

Currently, CANpro version 7.5 is installed.
The program file's version in this Update is 8.0

You can update the software product and machines or add new machines. When asked, check only the components you want to update.

Important!
If you want to update software product (Component 'CANpro files'), security dongle software will also be updated as well. For that, you need to have administrator privileges.

Display shows installed and updated version

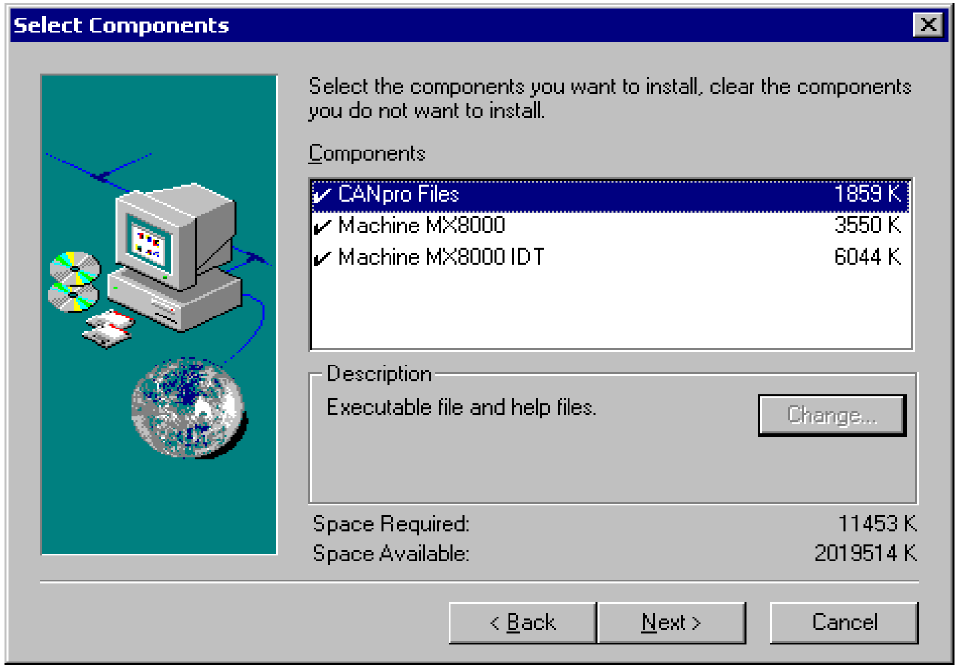
Figure 13-26: Information for Update

3. Click **Next** to update CANpro, default machine descriptions, or both.

NOTE:

The CANpro program and the default machine description may be updated separately or together. If you update CANpro, new drivers are installed and you are prompted to restart the PC. This does not occur if you are only updating the machine description.

4. Select the components you want to install and click **Next**. File copying begins immediately.



Select Components

Select the components you want to install, clear the components you do not want to install.

Components

✓ CANpro Files	1859 K
✓ Machine MX8000	3550 K
✓ Machine MX8000 IDT	6044 K

Description

Executable file and help files.

Space Required:	11453 K
Space Available:	2019514 K

Figure 13-27: Select Components Dialog Box

5. Restart the PC if prompted to do so.

CANpro CAN Test Tool User’s Guide

Introduction

The CANpro CAN Test Tool is a powerful tool for the development and execution of reproducible tests cases for CT machines that use CAN as an internal communication bus between micro controllers.

CANpro can be used for executing test scenario files that help you locate defects and errors on a CT scanner. All files that describe the actual model of the scanner are located on the scanner’s host computer. At test start, you connect the CANpro PC to the host by an ethernet link and provide the IP-address of the host. Then CANpro connects, downloads and encrypts all these files for you. CANpro will not work with un-encrypted scenarios or description files unless you are using a developer’s security key, which is not available to the field. All files are stored locally using a machine name you define as the directory.

CAUTION

NEVER USE THE SAME MACHINE NAME FOR TWO DIFFERENT MACHINES.

CANpro provides three function groups:

- *“CAN Telegram Monitoring”*
- *“CAN Telegram Simulation”*
- *“Flash Load and Read”*

NOTE:

The CANpro Version 8.1 Test Tool runs on the Windows 98/ME/NT/2000 operating system. The user is presumed to have a basic knowledge of working in a Windows environment. For help regarding Windows, refer to the operating system documentation.

Definitions

The following is a list of short definitions for terms encountered in this document:

Background protocol file	A plain, ASCII format file created by the **CANpro** monitor. It contains all interpreted telegrams & comments regardless of the current telegram filtering options. The extension is "**.fullcpf**" (**full C**ANpro **P**rotocol **F**ile).
Bit type	Type specifier used to describe parameters in command and table description files. **Parameters**: <type> **bit_type** <unit> **-** (not significant) <scale> **-** (not significant) <no_of_bytes> 0 <byte_addr> unsigned integer value <bit_addr> 0 to 7 **Values**: 0 (OFF) or 1 (ON). **Operators**: ==, !=, val These operators my be used in an expression in a scenario file with this type.

Block	One or a sequence of scenario commands. <block> ::= <canpro_command_or_structure> [<canpro_command_or_structure>]*
Comment	Blank lines, any line beginning with a **#** or a ***/*** or any line with a **#** or a ***/*** as the first character after white space in a scenario or description file is treated as a comment and therefore ignored by CANpro when analyzing the file. Proposed convention: use **#** for comment texts and ***/*** to comment out lines of code!
CAN command	Command interchanged between microcontrollers as a CAN telegram. The command name consists of one or two upper case letters, e.g., "E" or "AS" and is defined in the machine's description files.
CAN identifier	Number between 0 and 2031 decimal (0x00 to 0x7ef hex) that expresses telegram priority. Each CAN telegram must have an identifier for the micro controller to recognize the telegrams that it must read.
Cycle table	Table sent to the Mx8000 / Mx8000 IDT gantry containing the sequence, cycle time, number of repetitions, etc. that should be executed and are defined in the mode table. The table is sent in CAN telegrams that start with T 0xf1 and T 0xf3. Therefore, this table is also called "TF1" respectively "TF3".
Data telegram	CAN telegram interchanged between micro controllers and other hardware such as Serial Link Input/ Outputs (SLIOs). CAN telegrams have identifiers, zero to eight data bytes and are not interpreted by CANpro.
Description	File in plain ASCII format containing precise information about how CANpro should interpret telegram content i.e. identifiers, CAN commands, and parameters. The extension is "**.dsc**" (Description file).

Float type	**Type specifier used to describe parameters in command and table description files.** **Parameters:** **<type> float_type** **<unit> a string expressing a unit, like "[m/s]" or "[kV]"** **<scale> a float number** **<no_of_bytes> 1 to 4** **<byte_addr> unsigned integer value** **<bit_addr> 0 or - (not significant)** **Values: neg. and pos. 64-bit float values, depending on size: 1 to 4 byte integer value multiplied with scale.** **Operators: >=, <=** **Scenario files containing float type specifiers may use expressions containing these operators.**
Flash timeout: parameters	**CANpro uses these times to delimit how long it will wait for the FC and FV in Flash Load, and the time the controller may use for the transmission of the whole firmware block in Flash Read. The times are input in seconds. Minimum is 1s. For a whole block, at least 5s are needed. Perhaps a value of 50s will be useful.** **Do not change the flash parameters unless there is a good reason to do so. Times should be incremented if time-outs in flash reading or flash loading occur.**
gantry_ hardware_ firmware.cfg	**A file that describes the current hardware - firmware configuration of a scanner. It contains a line giving controller name, hardware revision, and firmware version for each controller.**

int_type	Type specifier used to describe parameters in command and table description files. **Parameters**: <type> **int_type** <unit> a string expressing a unit, like "[m/s]" or "[kV]" <scale> a float number (should have integer value) <no_of_bytes> 1 to 4 <byte_addr> unsigned integer value <bit_addr>0 or - (not significant) **Values**: negative and positive 32-bit integer values: 1 to 4 bytes multiplied with the scale **Operators**: ==, !=,>=, <=, >, <, val, & Scenario files containing int type specifiers may use expressions containing these operators.
MCU filament current correction	"MCUFilamentFile.cfg" contains information that is changed according to the tube aging process of the particular scanner and is downloaded from the host if a connection exists. Mode table fragments containing the "filament current" parameter are replaced by actual values looked up from the host.
Mode table	Table sent to the Mx8000 / Mx8000 IDT Gantry containing the parameters for all modes that should be executed. The table is sent in CAN telegrams that start with T 0xf0 and T 0xf2; therefore this table is also called "TF0" respectively "TF2".
Protocol file	Plain file (extension = “**.cpf**” for **CANpro P**rotocol **F**ile) in ASCII format created by CANpro containing interpreted telegrams and comments. Telegram identifiers may be used to filter out unwanted telegrams.
Remote frame	CAN telegram interchanged between micro controllers and other hardware such as Serial Link Input/Outputs (SLIOs). Remote frames have no identifiers, contain no data and set the remote bit.
Scenario file	File in plain ASCII format containing simulation commands and control structures to be executed by CANpro during simulation. The extension is "**.tsc**" (Test Scenario).
SLIO	Serial Linked Input/Output. Special Hardware components that can send and receive data telegrams and remote frames.

String type	Type specifier used to describe parameters in command and table description files. **Parameters**: <type> **string_type** <unit> **-** (not significant) <scale> - (not significant) <no_of_bytes> 1 to 7 (commands, limited by data length of telegram) or 1 to 5 (tables, limited by table fragment length). <byte_addr> unsigned integer value <bit_addr> 0 or **-** (not significant) **Values**: simple ASCII character strings (printable chars < 128) **Operators**: ==, != Scenario files containing string type specifiers may use expressions containing these operators.
System comments	(Protocol File Comment) The following types of protocol file comment lines make it more readable: **##**comments inserted by the user (typed directly or through scenario command) **!!**system comments about monitoring, start/stop, driver errors and external program execution inserted by CANpro **SI**simulation command executed (optional)
Time stamp	Absolute time point displayed in Hours:Minutes:seconds:milliseconds. The CAN driver creates relative time values the moment it reads them from or sends them to the CAN bus. Relative time values are converted to absolute time stamps, related to host time if a connection exists with the host computer or to local PC time if a connection does not exist. Absolute time stamps are then passed to CANpro with the telegrams.

Uint type	Type specifier used to describe parameters in command and table description files. **Parameters**: <type> **uint_type** <unit> a string expressing a unit, like "[m/s]" or "[kV]" <scale> a float number (should have integer value) <no_of_bytes> 1 to 4 <byte_addr> unsigned integer value <bit_addr> 0 or - (not significant) **Values**: positive 32-bit integer values: 1 to 4 bytes multiplied with the scale **Operators**: ==, !=,>=, <=, >, <, val, & Scenario files containing uint type specifiers may use expressions containing these operators.
User defined type	Parameter type used to describe parameters in command and table description files. **Parameters**: <type> <type_identifier> of some type defined in the type definition part of the same description file. <unit> **-** (not significant) <scale> - (not significant) <no_of_bytes> 1 to 2 <byte_addr> unsigned integer value <bit_addr> 0 or **-** (not significant) **Values**: 8 or 16 bit integer values for which symbolic names are defined in the type definition. **Operators**: ==, !=, val Scenario files containing user defined type specifiers may use expressions containing these operators.

Getting Started

Before starting CANpro, make sure that the *"CAN Dongle:"* is connected. (Connect the *"Security Dongle:"* as well, on systems without K2000).

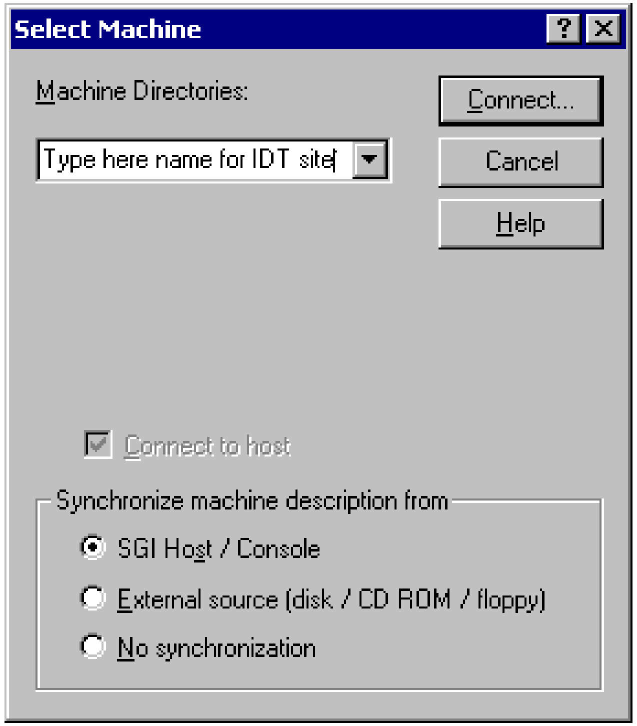
To work with a scanner, ensure that you have the following:

- Ethernet connection to the scanner host
- Host IP address
- CAN bus connection from the CAN dongle to the scanner

NOTE:

For Mx8000 IDT—run the CANpro tool from the mxservice user on the host. Select **Service | CANpro Enabler** to execute the dummy TLC application.

1. On the laptop taskbar, click **Start**, and then click **Program Files | CANpro** to run CANpro 8.1. The Select Machine dialog box appears (see *Figure 13-1*).
2. Type the site name in the Machine Directories text box, click the **SGI Host / Console** option, and then click **Connect**. The Console IP Address dialog box appears (see *Figure 13-2*).



Machine Directories: Type here name for IDT site

☑ Connect to host

Synchronize machine description from

● SGI Host / Console

○ External source (disk / CD ROM / floppy)

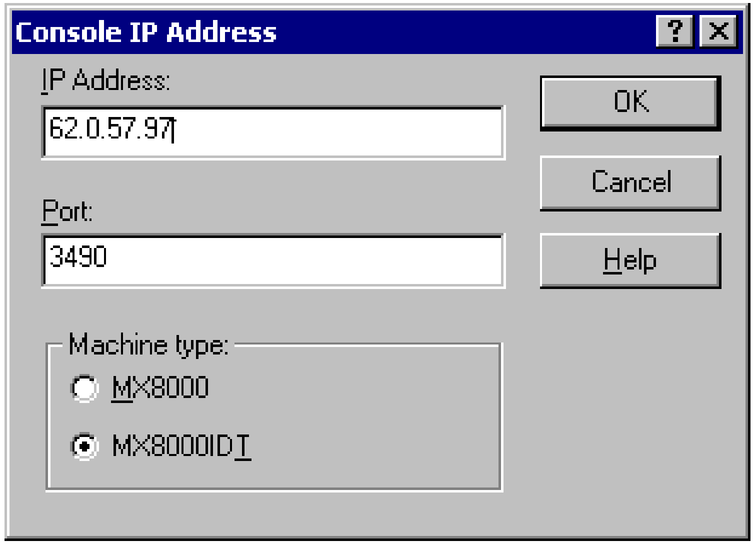
○ No synchronization

Figure 13-1: Select Machine Dialog Box

3. Type the IP address of the CT site in the IP Address text box, click the **Mx8000 IDT** option, and then click **OK** (see *Figure 13-2*).

CAUTION

DO NOT CHANGE THE PORT NUMBER.
THE PORT NUMBER REMAINS 3490



Console IP Address

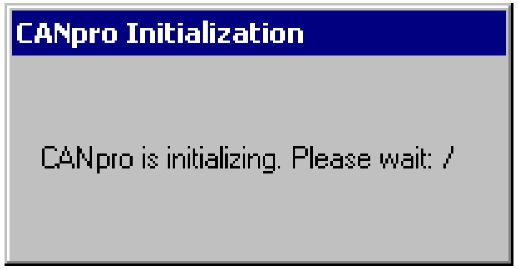
IP Address: 62.0.57.97

Port: 3490

Machine type:
○ MX8000
● MX8000IDT

Figure 13-2: Console IP Address Dialog Box

CANpro synchronizes the machine description with the host. This means, it does an FTP download of scenarios, description files, HTML error files etc. corresponding to this particular machine. It takes about three minutes for a first-time download, and about thirty seconds for subsequent downloads. A message appears during downloading (see *Figure 13-3*).



CANpro Initialization

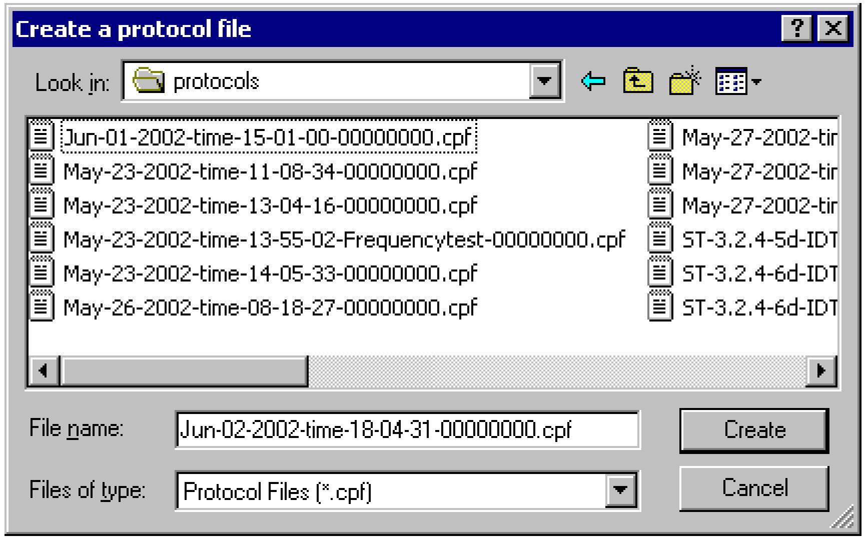
CANpro is initializing. Please wait: /

Figure 13-3: CANpro Initialization Message

4. After the download is complete, the Create a Protocol File dialog box appears (see *Figure 13-4*). Type a file name in the File name text box or accept the default file name, and click **Create**. The Protocol Monitor window appears (see *Figure 13-6*).

CANpro also connects to a socket on the host for the following special purposes:

- Synchronization of *“Time stamp”*
- Using the host Thermal Load Calculator for avoiding damages to the X-ray tube



Look in: protocols

Jun-01-2002-time-15-01-00-00000000.cpf
May-23-2002-time-11-08-34-00000000.cpf
May-23-2002-time-13-04-16-00000000.cpf
May-23-2002-time-13-55-02-Frequencytest-00000000.cpf
May-23-2002-time-14-05-33-00000000.cpf
May-26-2002-time-08-18-27-00000000.cpf
May-27-2002-ti
May-27-2002-ti
May-27-2002-ti
ST-3.2.4-5d-IDT
ST-3.2.4-6d-IDT
ST-3.2.4-6d-IDT

File name: Jun-02-2002-time-18-04-31-00000000.cpf

Files of type: Protocol Files (*.cpf)

Figure 13-4: Create a Protocol Dialog Box

CAUTION

FOR MX8000 IDT SCANNERS:

A dummy TLC is used in the host software version 2.0. There is an automatic delay between scans to protect the X-ray tube. The following message appears:
"An Automatic Delay of 2 minutes is activated with each scan to protect the X-ray tube. If you run X-ray scans of longer than 50 seconds, wait at least five minutes between scans." After running an X-ray scan of 50 seconds from the CANpro, wait at least ten minutes before running a similar scan from the host.

Both virtual connections to the host need to be successful for CANpro to execute all its functionality in the safest possible way.

You will not be able to do scans with an X-ray under any of the following conditions:

- The FTP download of files was not successful.
- The existing machine description selected is not identical to the one on the scanner machine's host.
- The socket connection to the host's Thermal Load Calculator could not be established.

If there are any fatal problems with the machine description you are trying to use, as connection problems, important description files missing, or others, you may need to choose an existing machine description. But normally, all files that you need will be found on the scanner machine's host. If you have a Development Engineering Security Dongle, you may need to create a different machine, correct the IP address, check the Ethernet cable, etc.

In case the console of the machine you are connecting to is not available, you can use the Mx8000 / Mx8000 IDT default description. It is not possible to choose the Mx8000 / Mx8000 IDT default description and download the files from the host (to overwrite it).

CAN Dongle:

The PEAK PCAN driver is installed with CANpro software. This driver by PEAK GmbH supports the PEAK CAN dongle you have received together with CANpro. For installation details see the installation manual.

CANpro configures the CAN dongle's CAN parameters according to the settings for the current machine. You do not need to change them.

CAUTION

YOU SHOULD NOT REMOVE THE PEAK CAN DONGLE WHILE WINDOWS NT IS RUNNING.

Security Dongle:

For working with CANpro, you need either a security dongle connected to one of your PC's parallel ports (received together with the software) or the K2000 security software (service users only) (see *Figure 13-5*).

If you use PEAK CAN dongle, that also needs a parallel port, you may connect both to the same port:

1. Connect the security dongle to the parallel port.
2. Connect the PEAK CAN dongle to the security dongle and to the PS/2-Port (or DIN port).

In case you are using the security software K2000, you can connect the PEAK CAN dongle directly to the parallel port. No special hardware is needed.

Your K2000 installation needs to be authorized to run CANpro. You get this authorization together with your regular K2000 permission updating.

CAN Cards and Drivers:

The CANpro CAN Test Tool can use a variety of CAN communication cards. The PEAK PCAN driver is installed with CANpro software. This driver by PEAK GmbH supports the following devices:

- PCAN-Dongle 11/29 BIT ID
- PCAN-Dongle Pro 11/29 BIT ID
- PCAN-ISA board 11/29 BIT ID
- PHYTEC ISA board (max 4 CAN controllers optically uncoupled) 11/29 BIT ID
- PCAN-PC-104 (max 2 CAN controllers optically uncoupled) 11/29 BIT ID
- PCAN PCI board 11/29 BIT ID
- PCAN USB Interface 11/29 BIT ID

The PEAK CAN dongle is used under normal conditions. For PEAK CAN driver installation details, see the CANpro CAN Test Tool Installation Manual (PMSTL P/N 491-7200-0160).

CANpro configures the CAN card's CAN parameters according to the settings for the current machine.

⚠ **CAUTION**

YOU SHOULD NOT REMOVE THE CAN COMMUNICATION CARD (E.G., THE PEAK CAN DONGLE) WHILE WINDOWS NT IS RUNNING.

Security Dongle or Security Software

You must have one of the following:

- Security dongle attached to the parallel port of the PC running CANpro
- K2000 security software installed and enabled

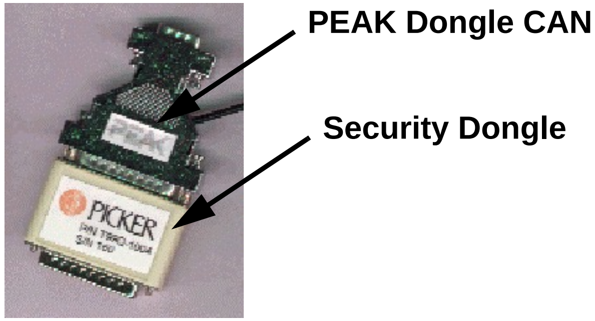


Figure 13-5: Security Dongle and PEAK CAN Dongle Piggyback

How Does Canpro Run in Real-time on Windows 98/ME/NT/2000?

The CANpro CAN Test Tool is designed to run in real time on Microsoft Windows NT/2000.

Is Windows NT a real time system? One may think so because it is certainly a multiprocessing system and several processes and threads can be running at the same time. The system has a scheduler that distributes time slices to the processes and threads.

Time slices on a Windows NT system have a standard duration of 20-30 ms. Threads have a dynamic priority that is constantly being changed as a consequence of waiting for system resources (and other things) even though you can assign a base priority to each thread. Running processes compete for system resources and processor time. Only thread(s) with the highest dynamic priority are served at a time. Windows NT scheduling is unpredictable. It cannot be guaranteed that a certain application gets enough processor time when or as often as needed if several processes are running on the same system. Even hardware interrupts are being scheduled if several of the same priority happens to be served at the same time. Windows NT can meet "soft" real time needs only if the real time program does not need to run together with other software not designed for this kind of situation. The same applies to Windows 98/ME, but the time slices can be shorter.

⚠ **CAUTION**

TO ACHIEVE ACCEPTABLE REAL TIME BEHAVIOR, DO NOT RUN OTHER APPLICATIONS IN PARALLEL WITH CANPRO WHILE CANPRO IS MONITORING, FLASH LOADING OR DURING SIMULATION. FOR THE SAME REASON, YOU SHOULD NOT USE A SCREEN SAVER.

Real-Time Needs of CANpro

The time limits CANpro is dealing with are on the order of a few milliseconds. Having more than a few telegrams wait for processing at any one time is avoided whenever possible even though they are stored in a CAN driver ring buffer and have already received a time stamp. Ideally, CANpro writes the telegram to the protocol file in about the same millisecond it was received. CANpro must respond within 50 ms to any telegrams received regardless of how fast they may appear at the CAN dongle during simulation. CANpro needs "soft" real time. Therefore, we have given the whole CANpro process a higher priority class to avoid big "time robbing" by time-consuming applications running in parallel.

Nevertheless, even lower-level applications will be executed once they have waited long enough to get their priority-boost, and parts of them may be executed on a higher priority level when they make system calls. Disk I/O, for example, is using hardware interrupts, which have a much higher priority level than any user application can have.

Safety Aspects of CANpro Use

WARNING

NEVER USE CANPRO FOR MAKING CT-SCANS OF PERSONS!

In the present release of CANpro, you can execute many kinds of test scenarios that are written according to the syntax of CANpro's simulation language.

The Thermal Load Calculator is now being used to avoid damages to the x-ray tube - it does not allow execution of scenarios that damage the Mx8000's x-ray tube.

CAUTION

FOR MX8000 IDT SCANNERS

A dummy TLC is used in the host software version 2.0. There is an automatic delay between scans to protect the X-ray tube. The following message appears:
"An Automatic Delay of 2 minutes is activated with each scan to protect the X-ray tube. If you run X-ray scans of longer than 50 seconds, wait at least five minutes between scans. After running an X-ray scan of 50 seconds from the CANpro, wait at least ten minutes before running a similar scan from the host.

But even with the tube heat calculator working, please remember that CANpro is a test tool:

- Only execute test scenarios if you understand what they mean, and for which purpose they have been written.
- If a test scenario contains x-ray producing commands, be sure that nobody is in the scanner room when you execute it.

Thermal Load Calculator (Heat Calculator, TLC)

Why do we Need it?

Due to the physics of the x-ray tube, it is required that the amount of energy stored in the x-ray tube be estimated and controlled in order to prevent the x-ray tube from suffering physical damage related to over heating. Thus, before more energy is applied to the tube, via an X-ray shot, an estimate of the tube's future heat load is calculated. This calculation must take into account present heat load, time of last shot, the tubes physical parameters, as well as the desired shot's duration and energy level (KV and mA).

If a sequence of multiple shots are required, then an understanding of the energy levels of each shot, duration of each shot along with time period between shots must be taken into account as well as the x-ray tube's present heat load condition.

How do we Use it?

For the Mx8000

CANpro uses automatically the built-in Thermal Load Calculator of the scanner machine host - if it is connected to it. It analyzes the test scenarios, as well as the values you can enter in the Manual X-Ray Dialog, while the scan parameters are being loaded to the gantry.

It uses this information for asking the TLC for scan permission before sending an "SE" command to the gantry.

If a scan is not allowed at the moment, a count down dialog box is displayed, announcing the time in hours, minutes and seconds, that is needed to cool the tube sufficiently down to execute all scans that are defined in the currently loaded cycle table. After this, the TLC is asked again for scan permission.

If a scan is not allowed at all, an error message is displayed and the current scenario is stopped.

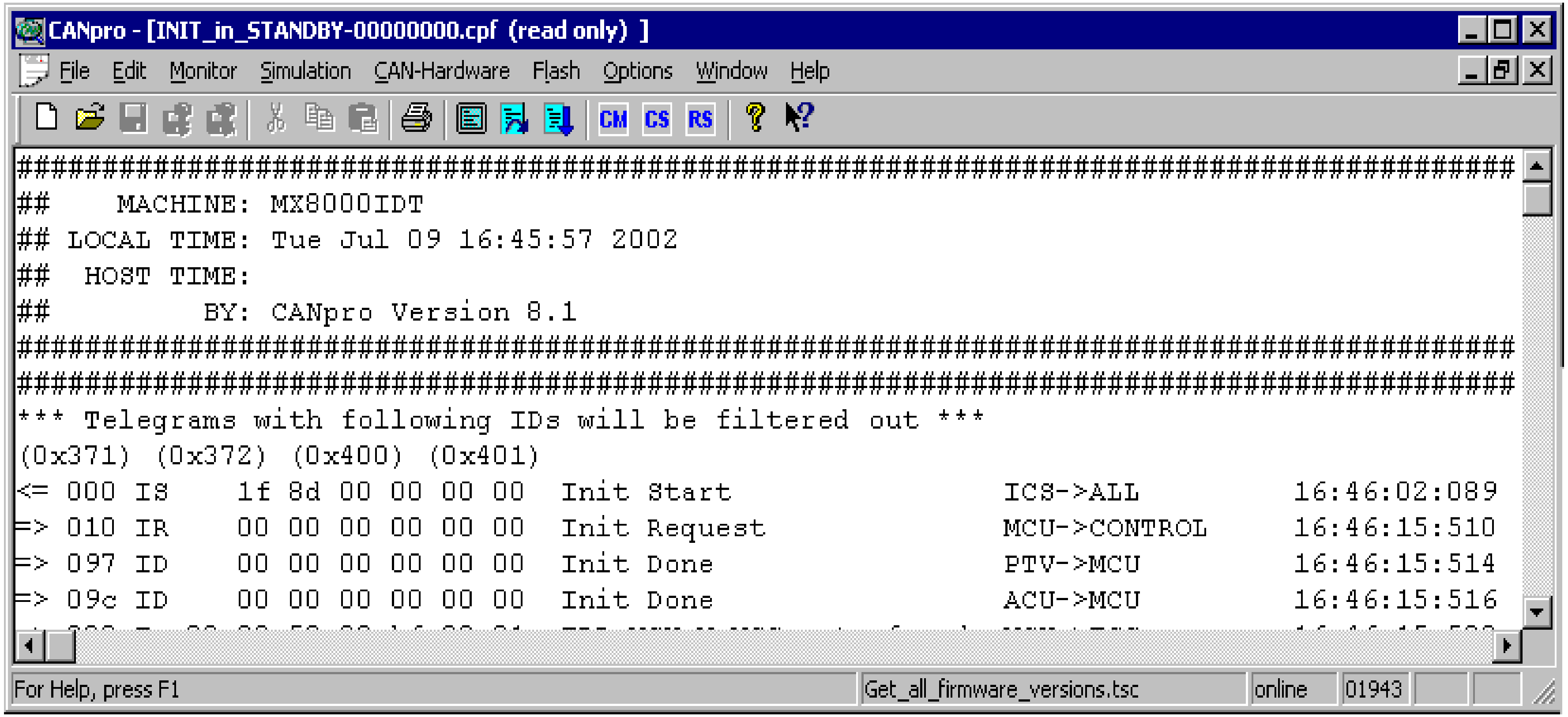
Then it checks the CAN telegrams that are returned by the gantry during the actual scan, and uses some of their parameters to update the TLC. Triggered by CANpro, the TLC calculates and stores internally always the current tube temperature as a result of executed scans and time passed since then.

In Field Service Mode, you cannot execute scans with an x-ray from CANpro if you are not connected to host. However, you can start scenarios to get diagnostics, test movements, or do scans without an x-ray.

CANpro User Interface

CANpro's main window is the Protocol Monitor Window (see *Figure 13-6*). It contains the following components:

- Menu commands
- Shortcut toolbar
- Standard protocol display (see *"CAN Operation"*)
- Status bar


CANpro - [INIT_in_STANDBY-00000000.cpf (read only)]
File
Edit
Monitor
Simulation
CAN-Hardware
Flash
Options
Window
Help
CM
CS
RS
For Help, press F1
Get_all_firmware_versions.tsc
online
01943

```
########################################################################################
##    MACHINE: MX8000IDT
## LOCAL TIME: Tue Jul 09 16:45:57 2002
##  HOST TIME:
##         BY: CANpro Version 8.1
########################################################################################
########################################################################################
*** Telegrams with following IDs will be filtered out ***
(0x371) (0x372) (0x400) (0x401)
<= 000 IS    1f 8d 00 00 00 00  Init Start                ICS->ALL         16:46:02:089
=> 010 IR    00 00 00 00 00 00  Init Request              MCU->CONTROL     16:46:15:510
=> 097 ID    00 00 00 00 00 00  Init Done                 PTV->MCU         16:46:15:514
=> 09c ID    00 00 00 00 00 00  Init Done                 ACU->MCU         16:46:15:516
```

Figure 13-6: Protocol Monitor Window

Menu Commands

File Menu

New

Create a new document with the New Protocol command.

New Protocol

Use this command to create a new protocol file in CANpro. The Create Protocol dialog box appears and a default name for the protocol file is proposed (a combination of current date and time). You are free to enter a different file name.

File Name:

Type or select the name of the file you want to create. A default name for the protocol file is proposed that is a combination of current date and time. You are free to enter a different file name.

A hyphen and a counter containing 8 digits with value 0 are automatically added to each file name. The file name itself without the counter and extension can contain up to 45 characters. If you enter a hyphen followed by an 8-digit number at the end of the file name, CANpro will consider it as a counter and will not add another one.

Extension ”**.cpf**” will automatically be added if you don’t enter it itself. As Windows (32bit) allows periods in file names, any different extension you enter is considered as a part of the file name, so ”**.cpf**” will be added after it.

If the entire file name (including counter and extension) already exists, CANpro will offer a dialog where you can choose to go on counting or overwrite the existing numbered files.

List Files of Type:

Select the type of file you want to see. The drive where you create the current protocol file must be a local hard disk drive.

Overwrite File Dialog

If you try to create a file that already exists, CANpro asks if you want to overwrite the file(s). If you select a protocol file with an existing name, CANpro checks (beginning with the current number) up to which number files with this name exist. If you enter a file name without the number, CANpro starts searching with 0. It offers you radio buttons with the following alternatives:

- Overwrite all files: Starts again with the number you have entered or with 0 if you haven’t entered any.
- Go on numbering: Uses the first number that is still free to create the new numbered file name.

Open Open an existing file in a new window.

Close Close all windows containing the active document.

> NOTE:
>
> Protocol files are saved automatically. You must first stop monitoring before closing the current protocol file.

Save Use this command to save the active document to its current name and directory. When you save a document for the first time, CANpro displays the Save As dialog box so you can name your document. If you want to change the name and directory of an existing document before you save it, choose the Save As command.

Save As Use this command to save and name the active document. CANpro displays the Save As dialog box so you can name your document. To save a document with its existing name and directory, use the Save command.

File Name:

Type a new filename to save a document with a different name. CANpro adds the extension you specify in the Save File As Type box. If it is a test scenario file, its file name without extension “**.tsc**” can contain up to 45 characters.

Print	Use this command to print a document. This command presents a Print dialog box, where you may specify the range of pages to be printed, the number of copies, the destination printer, and other printer setup options.
Print Preview	Use this command to display the active document, as it would appear when printed. When you choose this command, the main window will be replaced with a print preview window in which one or two pages will be displayed in their printed format. The print preview toolbar offers you options to view either one or two pages at a time; move back and forth through the document; zoom in and out of pages; and initiate a print job.
Page Setup	Use this command to define the setup of a printed page. A Page Setup dialog box appears, to define header and footer. **Page Setup Dialog Box**: You can define the contents of the header and footer printed on each page. Both of them consist of a text that you specify in the edit fields. The text can contain the following variables: • **&f** current **file name** • **&p** current **page number** • **&t** **time** (when you print the document) • **&m** **modified** time (last time the document was modified)
Print Setup	Use this command to select a printer and a printer connection. This command presents a Print Setup dialog box, where you specify the printer and its connection.
1, 2, 3, 4 ... command	Use the numbers and file names listed at the bottom of the File menu to open one of the latest documents you closed. Choose the number that corresponds with the document you want to open. **NOTE:** With the number commands, you always open a document for reading only. If you want to open it reading and writing, use the **Open** command!
Exit	Use this command to end the CANpro session.

Edit Menu

Undo	Edit windows only. Use this command to reverse the last editing action, if possible.
Cut	Edit windows only. Use this command to remove the currently selected data from the document and put it on the clipboard. This command is unavailable if there is no data currently selected. Cutting data to the clipboard replaces the contents previously stored there.
Copy	Edit windows only. Use this command to copy selected data onto the clipboard. This command is unavailable if there is no data currently selected. Copying data to the clipboard replaces the contents previously stored there.
Paste	Use this command to insert a copy of the clipboard contents at the insertion point. This command is unavailable if the clipboard is empty.

Find

Use this command to search for specific text. When the active window contains an editable file (description file or test scenario file), this command presents the standard Find dialog box, where you specify the text you want to find. When the active window contains a CANpro protocol file, this command presents the Search For Telegram Dialog Box where you specify the text you want to find in the protocol file.

Find Dialog Box

The dialog box lets you specify which text to find and which rules are valid for search:

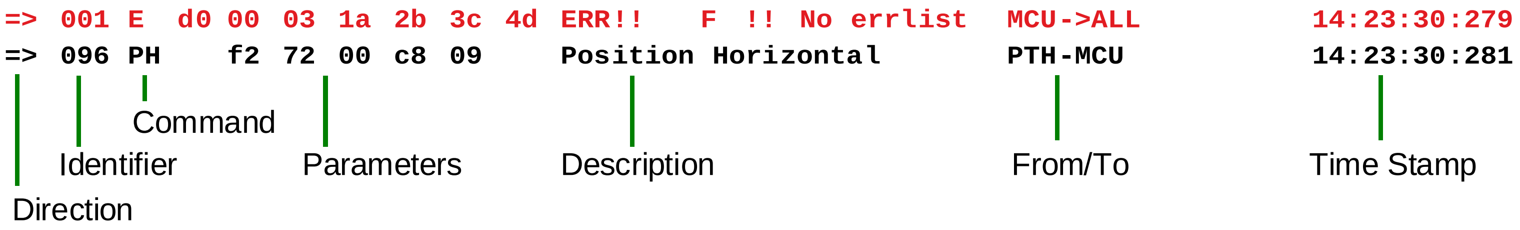
- **Search for**:Type text in the edit field that you want to find.
- **Case Sensitive**:If this option is turned ON, only text that is written exactly as specified matches. Otherwise uppercase/lowercase writing is not relevant.
- **Direction**:If Up is selected, the search will be done from current position towards beginning of the document. If Down is selected, the search will be done from current position towards end of the document.
- **Find**:Clicking this button finds next occurrence of the specified string in your document.
- **Cancel**: Finishes the find activity.

NOTE:

The Find dialog box remains displayed until you press the Cancel button. So you can search the next occurrence of the specified string without specifying it again.

Search for Telegram Dialog Box

Specific search function for monitor protocol files that helps find a text string in one or more defined parts of an interpreted CAN telegram. One or more sections of the telegram interpretation line are selectable. To search comments and error texts in protocol files, clear the **Telegrams only** check box.



```
=> 001 E d0 00 03 1a 2b 3c 4d ERR!!  F  !! No errlist MCU->ALL        14:23:30:279
=> 096 PH   f2 72 00 c8 09    Position Horizontal      PTH-MCU         14:23:30:281
```

Figure 13-7: Search for Telegram Explanation

Replace Command

Edit windows only. Use this command to substitute a specific text in the document by a different one. This command presents a Replace dialog box, where you specify which text you want to replace by which substitution.

Replace Dialog Box

The dialog box lets you specify which text to replace by a different one and which rules are valid for substitution:

- **Find**:Type in the text you want to replace by a different one.
- **Replace with**:Type in the text you want to set.
- **Case Sensitive**:If this option is turned ON, only text that is written exactly as specified matches. Otherwise uppercase/lowercase writing is not relevant.
- **Find Next**:Finds the next occurrence of the searched text without replacing it.
- **Replace**Replaces the currently selected text by the substitution text.
- **Replace All**:Replaces all occurrences of the searched text by the specified substitution text.

Monitor Menu

Start	Use this menu command to start CAN monitoring. You can not start the monitor unless there is an open protocol file the telegrams can be stored in. If no protocol file is currently open, the Create Protocol dialog box will be displayed and you are asked to create a new protocol file first. If you create a new protocol file, the monitor will start and append arriving CAN telegrams to this file that is displayed in the protocol window. If you leave the Create Protocol dialog box with the Cancel button, the monitor will not start. With the menu function Options Telegram Interpretation you can dynamically select which CAN Command and table telegrams shall be interpreted in detail, so that you can observe the parameter contents. You can call this option before and during monitoring.
Stop	Use this command to stop CAN Monitoring. The protocol file remains open. No CAN telegrams will be appended to the protocol file any more. When monitoring is OFF, CANpro still fetches the telegrams from the CAN driver and throws them away.
Monitor Comment	Use this command to insert a comment to the current protocol file. The Monitor Comment dialog box will appear for editing the comment text. As soon as you press the OK button, the comment text will be appended to the protocol file. If you have some standard texts that you want to append more frequently, you may prefer using predefined comments. Monitor Comment Dialog Box Dialog box for editing a comment text to be appended to the current protocol file. You can use up to 90 Characters. The text will be introduced by "##" at the beginning of line in the protocol file.
Interpret Telegram	Use this command to show the CAN command selected in a protocol file in detailed interpretation in a separate window. The CANpro Telegram Interpretation Window will appear. It remains displayed until you close it by clicking the OK-Button. CANpro Telegram Interpretation Window Separate window in which the detailed interpretation of the CAN command selected in a CANpro protocol file is displayed. **OK** closes the window.

Search for Telegram

Use this command to search for a telegram in the current protocol file that contains a specific text in one or more fields of the interpreted telegram; for example, in the identifier, the parameters, the short text or the time stamp. The Search for Telegram dialog box appears. To search also comments and error texts in a protocol file, clear the Telegrams only check box.

Gantry Status

Use this menu option to open the Gantry Status Window, where you get information about the current gantry status.

Simulation Menu

Simulation Load

Use this menu command to load a scenario file. The Load Scenario dialog box for specifying the scenario name appears. The scenario file is examined for syntax errors, and if any are found, will be opened in an edit window. Re-edit it and load it again! If the scenario file contains identifiers or CAN commands not defined for the current machine, only a warning will be given and the scenario file is loaded. When the scenario is loaded, the scenario filename is displayed in the status bar.

Load Scenario Dialog Box

The following options allow you to specify which file to open:

- **File Name**:Type or select in the file list the filename you want to open. Click **Details** above the file list to see details of the files.
- **List Files of Type**Open scenario files with extension "**.tsc**".

Click Description to get more information about the currently selected scenario name in the file list.

Simulation Load with Filament Corrections

Use this menu command to load a scenario file with filament current correction. The Load Scenario dialog box for specifying the name of the scenario file appears. When the selected scenario is loaded, the mode table fragments that contain the "filament current" parameter are replaced by different values, that have been looked up in a MCU Filament file downloaded from the host. This file contains information that is changed according to the tube aging process.

Simulation Start	Use this menu command to start the loaded scenario file. The file is executed. You must load a scenario before you can run it. Simulation Running Dialog Box This dialog is opened when you run a simulation scenario and its purpose is to remind you that a scenario is active. When “Abort scan and gantry movements when aborting Scenario” under **Options**, **Simulation** is set and the Abort Scenario button is pressed, the CS command is automatically sent to the gantry and the simulation stops running.
Manual X-ray	Use this menu option to interactively configure a subset of scan parameters and switches to allow basic x-ray production. You can alter a set of parameters and switches. The Manual X-ray dialog box appears.
Mode Table Switch Settings	This feature allows the user of CANpro to disable (force to 0), enable (set to 1), or not alter (use the defined value found in the scenario) given switches in mode tables TF0 and TF2 when a scenario is run. The values you choose here are used for all scenarios that are started after setting them, including the currently loaded scenario. Use the "**Clear All**" button to undo all switch settings (after pressing **OK**, all scenarios will be executed without any switch changes).

⚠ CAUTION

IF YOU SET "X-RAY" ON, "ROTATING ANODE" MUST ALSO BE ON. OTHERWISE, THE TUBE WILL BE DAMAGED. FOR FIELD SERVICE USERS, THIS IS ADAPTED AUTOMATICALLY BY CANPRO.

NOT ALL POSSIBLE COMBINATIONS ARE ALLOWED. YOU CAN DAMAGE THE SCANNER MACHINE IF YOU DO NOT KNOW EXACTLY WHAT YOU ARE DOING.

1, 2, 3, 4 ... Command	Use the numbers and file names listed at the bottom of the Simulation menu to load and run one of the latest scenarios you loaded. Choose the number that corresponds with the scenario file you want to run.

CAN Hardware Menu

Reset Card	Use this command to force a physical RESET of the currently used CAN card. The use of this command during monitoring may cause the loss of incoming and outgoing telegrams that are stored in the CAN driver’s internal ring buffer. CANpro therefore appends a system comment to the current protocol file, that a hardware reset has taken place.

Flash Menu

Flash Read	See *“Flash Read Procedure”*
Flash Load	See *“Flash Load Procedure”*
Load Complete Configuration	See *“Loading Complete Configuration”*

Options Menu

Change Machine

Use this menu command to select a different machine. The Select Machine dialog box appears. If you select a new machine there, CANpro will unload all description files. CANpro will try to synchronize again with the host, and load the description files provided with the selected machine. The CAN driver configuration will be adapted using the CAN parameters of the selected machine. If you cancel the dialog immediately, you will get back to the previously selected machine. If you have already tried to load one that failed, the easiest thing is to select the previously loaded machine again.

Select Machine Dialog Box

In this dialog box that is displayed at program start you can enter or select the name of the machine description you want to use. See your options as field service user for more information. In the Service User field, you can either:

- Enter a new machine name and synchronize the machine descriptiongloss_machine with the host

> **NOTE:**
>
> In the following cases, you cannot execute test scenarios with X-ray.

- Enter a new machine name and get the machine description from an external source.
- Select an existing machine name (including the default machine "Mx8000" / "Mx8000 IDT") and make no synchronization with host.

If you select an existing machine and try to synchronize files with host, you will be allowed to do scans with X-ray only if all files are exactly the same in the machine directory and on the host.

Remove Machine

Use this menu command to remove any machine from the list of selectable machine descriptions.

NOTE:

- You cannot remove the currently selected machine.
- You cannot remove the default machine "Mx8000 / Mx8000 IDT".

Remove Machine Dialog Box

The dialog box shows a list of all machines that have been already defined with CANpro on your PC. You can remove a machine by clicking a machine name in the list.

Telegram Interpretation

Use this menu command to select which CAN commands and tables the monitor should interpreted in the long form, displaying also parameter values. The Telegram Interpretation Options dialog box appears.

Telegram Interpretation Dialog Box

The dialog box shows a list of all available CAN commands and a list of all available tables. The selected CAN commands and tables are interpreted by the monitor in the following way in the protocol file:

One or several lines follow the interpreted telegram line, one for each parameter that is described in the description file. It contains the parameter's name (label), and its value. Depending on the parameter type, it is scaled with a scale factor and a unit is displayed in case of integer or float values, or a textual interpretation of the value is given in case of user-defined types.

If a table is selected, the information for each parameter is given in the same way as for command telegram contents. The only difference is that only a fragment of the table is interpreted, since a table is transmitted in several telegrams. The deselected CAN commands and tables are interpreted in the short form.

You can select / deselect commands or tables by clicking on the entries of the lists. The entries toggle between the states selected and deselected. However, if you select a CAN command that has no parameters, or its description file has not been loaded, its interpretation does not change.

For quick selection you can:

- Deselect all commands/tables by the option **none**
- Select all commands/tables by the option **all**

Remark: You can also change these settings during monitoring!

Telegram Filtering

Use this menu command to open a dialog where you can decide which CAN identifiers will be contained and which will be left out in the (foreground, visible) protocol file. However, all kinds of telegrams will be contained in the background protocol. The information about which IDs are currently filtered out is added to the protocol file on file start and any change of the option.

HTML Error Description

Use this menu command to open a file dialog where you can select all HTML Error description files of the current machine for viewing. The files are grouped in sub directories by the controller name. There is a main list, "errors.html", that allows you the access to the controller specific lists, and to the individual files. You can obtain the correct file directly for any "**E**" telegram that has been monitored by double-clicking the line of this telegram in the protocol file.

Monitoring

Use this menu command to set the options the monitor uses for protocol file creating, naming and numbering. The Monitoring Options dialog box appears.

Monitoring Options Dialog Box

- **Start Monitor on CANpro Start**:Select to start monitor automatically at next CANpro start. Enter a protocol file name.
- **Protocol File Name Created**When a scenario file is loaded, a protocol file is created automatically, and the monitor starts.
  from Scenario Name The file has the same name as the scenario file, with some digits for counting and the extension ".cpf".
- **Protocol File Name Given by User**Use the **File | New | New Protocol** command and type in the name or select an existing name.
- **Default Path to Protocol Files**Specifies the path offered by default for the File New Protocol, File Open, and Save As commands for protocol files. This path is also changed if you create a protocol file with a different path using the File New Protocol command.

The current monitoring options are user specific and will be saved at the end of CANpro execution.

Simulation

Use this menu command to set the options for simulation. The Simulation Options dialog box appears.

Predefine Comments

Use this command to define up to 10 monitor comments, which can be appended to the end the current monitor protocol file by pressing the hotkeys: Ctrl-0 ... Ctrl-9. The Predefine Monitor Comments dialog box appears. The defined monitor comments are user specific and they are automatically stored on program termination.

Predefine Monitor Comments Dialog Box

In this dialog box you can define up to 10 monitor comments. For each comment you can use up to 90 Characters. You can insert them into the current protocol file by pressing **Ctrl-<number>**. The text will be introduced by "##" at the beginning of line in the protocol file.

This option may be useful to all users, in case you observe something interesting sporadically, and you do not want to or cannot write a scenario for marking the place where it occurs. You can also use it for observations you make of the scanner machine itself, as: "table is moving in" or "gantry movement did not stop".

Advanced

Internal Log

Use this menu command to have a look at or change the settings for the CANpro internal log file. Purpose: this is an internal function that helps us testing CANpro. You do not need to use it normally, only if you are asked for by CANpro developers.

Font

Use this menu command to change the font used by CANpro. The Font dialog box appears.

> **NOTE:**
>
> The selected font is used for all CANpro windows, as well as for printing.

Font Dialog Box

- **Font Name**:Only fixed fonts are offered. The readability of the protocol files benefits from alignment of telegram contents.
- **Font Attributes**Choose between Normal, Italic, Bold, and Bold Italic.
- **Font Size**Select a size in the range from the smallest to the largest offered value.

Font settings are user specific. They will be saved at the end of CANpro execution.

Tab Stops

Use this menu command to change the tab stop value used by CANpro. The Tabulator dialog box will appear.

> **NOTE:**
>
> The selected tab stop is used for all editable CANpro windows, as well as for printing.

Tabulator Dialog Box

In this dialog you can change the tab stop value generally used by CANpro. In the edit field you can specify the width (measured in character positions) between each two tabulator stop positions. The current tab stop value is user specific. It will be saved at the end of CANpro execution

Save

Use this menu command to save the currently set options immediately in the registry. The options are always saved at the normal end of the program.

Window Menu

New Window	Use this command to open a new window with the same contents as the active window. You can open multiple document windows to display different parts or views of a document at the same time. If you change the contents in one window, all other windows containing the same document reflect those changes. When you open a new window, it becomes the active window and is displayed on top of all other open windows.
Cascade	Use this command to arrange multiple opened windows in an overlapped fashion.
Tile	Use this command to arrange multiple opened windows in a non-overlapped fashion.
Arrange Icons	Use this command to arrange the icons for minimized windows at the bottom of the main window. If there is an open document window at the bottom of the main window, then some or all of the icons may not be visible because they will be underneath this document window.
1, 2, 3, 4, ... Command	CANpro displays a list of currently open document windows at the bottom of the Window menu. A check mark appears in front of the document name of the active window. Choose a document from this list to make its window active.

Help Menu

Overview and Index	Use this command to display the opening screen of Help. You can either use the **Contents** page to look for a topic or you can use the **Index** page to find topics containing the keyword or you can use the **Search** page to find all topics which texts contain the searched word.
Using Help	Use this command for instructions about using Help.
About	Use this command to display the copyright notice and version number of your copy of CANpro. You will also find here useful information about the CAN card, the driver version, the security dongle, as well as general information about available memory and disk space (on the hard disk your protocol files are being written to).

Shortcut Toolbar

The toolbar contains six CANpro specific toolbar buttons in the following two groups (see *Figure 13-8*):

- Action buttons
- Telegram buttons

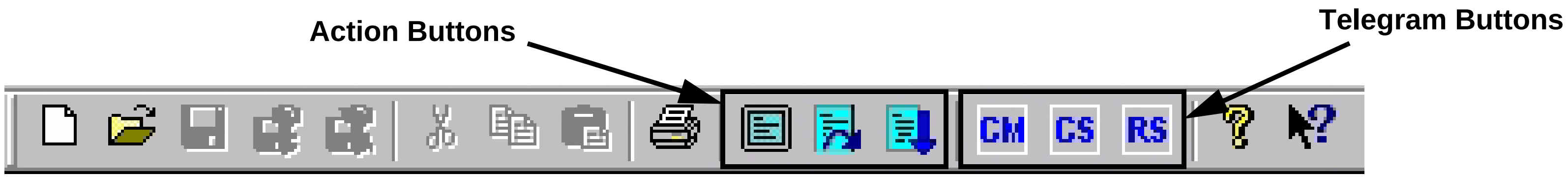


Figure 13-8: Shortcut Toolbar

Action Buttons

Start / Stop CAN Monitor	Click to toggle the CAN Monitor On / Off.
Load Scenario	Click to load a scenario file.
Start Scenario	Click to start a loaded scenario.

Telegram Buttons

CM	Cancel Mode	Click to send a Cancel Mode telegram.
CS	Cancel Scan	Click to send a Cancel Scan telegram.
RS	Reset Start	Click to send a Reset Start telegram.

Status Bar

The status bar is displayed at the bottom of the CANpro window (see *Figure 13-9*).

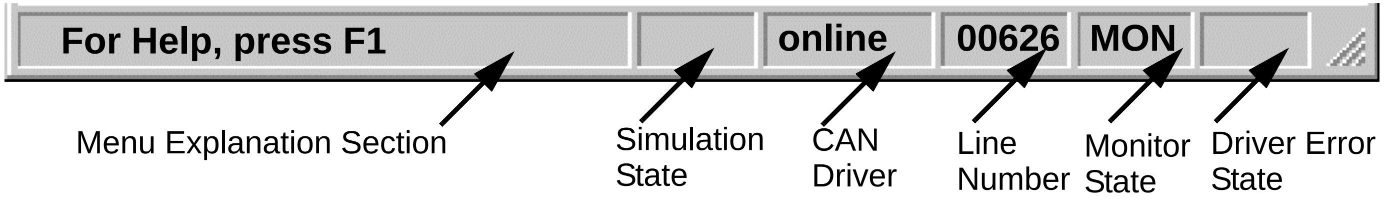


Figure 13-9: Status Bar

Status bar contents from left to right:

Menu explanation section:	Leftmost area of the status bar. Describes actions of menu items as the arrow keys are used to navigate through menus. Also shows messages that describe the actions of toolbar buttons as the mouse passes over them. You do not need to press the left mouse button to view the description. If you happen to click the toolbar button but do not wish to execute the command, release the mouse button when the pointer is off the toolbar button. Activity progress is displayed here for those activities that take longer periods of time to complete, e.g. initialization.
Simulation state:	The name of the currently loaded scenario file, or empty.
CAN driver:	"Online" if a CAN driver is installed and the hardware has been successfully initialized, or "offline" if no driver is connected or there is no hardware.
Line number	Number of selected line in the active protocol file.
Monitor state	"MON" if the monitor is running, or empty.
Driver error state	"ERR" if a driver error that may cause loss of telegrams has been detected since the last protocol file has been opened by user action, else empty.

CAN Operation

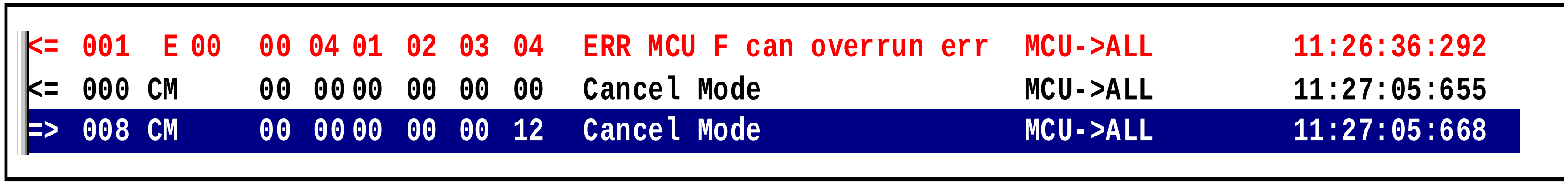
CAN Telegram Monitoring

CAN Telegram Monitoring monitors and interprets communications on the CAN bus between micro controllers and host and to and from *“SLIO”*s. Monitored telegrams are saved in plain ASCII format *“Protocol file”*s. A *“Time stamp”* is added to each telegram.

NOTE:

To achieve acceptable real time behavior, do not run other applications in parallel to CANpro while CANpro is monitoring.

The CANpro CAN Test Tool reads, interprets, displays and records all telegram types (*“Data telegram”*, *“CAN command”* and *“Remote frame”*) transmitted on CAN bus. They are interpreted using the currently selected machine’s description files, displayed on the screen and recorded in a protocol file. Several types of description files define the *“CAN identifier”*, commands and tables of a machine. All description files for the current machine are loaded during CANpro initialization. The standard display format consists of one line of interpreted text for each telegram (see *Figure 13-10*).



```
<=  001  E 00  00  04 01  02  03  04   ERR MCU F can overrun err  MCU->ALL      11:26:36:292
<=  000 CM     00  00 00  00  00  00   Cancel Mode                MCU->ALL      11:27:05:655
=>  008 CM     00  00 00  00  00  12   Cancel Mode                MCU->ALL      11:27:05:668
```

Figure 13-10: Standard Display Format

“**=>**” and “**<=**” are the symbols for incoming and outgoing telegrams. The number following “**=>**” or “**<=**” is the CAN identifier in hexadecimal format. Telegram contents (if any) are displayed after the identifier:

Command name:	The command name is displayed followed by the parameter contents as hex bytes. Then, short text is displayed that explains the command’s name.
Data telegrams:	Data contents are displayed as hex bytes. Then, short text is displayed that explains the SLIO state number’s interpretation.
Remote frames:	Never have contents. The short text is always “Remote Frame”.

Interpreting text for CAN identifiers follow telegram content and the last item is always the time stamp.

From the **Options Menu**, select **Telegram Interpretation** to select command telegrams and tables for detailed interpretation of parameter contents, which are then added to the display.

Description File Types

Error lists:	An error list contains error numbers and short texts for one micro controller. The file name is "ERR_<err_cmd_name>.dsc" <err_cmd_name> ::= E<hex_controller_number>
Syntax:	<err_list_line> ::= <err_num> <err_short_text> <err_num>: a decimal or hex number of 1 byte <err_short_text>: [<simple-ascii-character>]1-15
Semantics	Error Lists are used for short interpretations of individual error numbers contained in the "E" command in telegrams. For each "E" telegram, instead of a command short text, the controller, the error priority and the error number are interpreted. CANpro finds the correct error list using the <hex_controller_number> (first parameter byte) of the telegram. Interpretation of the controller name corresponding to the <hex_controller_number> and error priority are taken from the "E.dsc" command description file, which must be written according to the common syntax of description files, where also the term <simple-ascii-character> is defined.
HTML error	An HTML error description exists that exactly explains the kind of error that has happened for any Error number sent by any scanner controller in an "**E**" command telegram. Double-clicking the line on which the error is reported in, will display a description of the possible causes of the error. Only fatal errors are displayed in red.
Machine description	This describes the machine to be tested. Machine description files are the definition of CAN command tables and identifiers used in micro controller firmware and may include appropriate test scenarios and firmware to load into the flash PROM. CAN parameters describe baud rate, etc. used on the CAN bus.

CAN Telegram Simulation

CAN Telegram Simulation is provided for machine testing. Telegrams normally sent from the host computer to the CT scanner are “simulated”, meaning they are sent using script files called ‘scenarios’. Scenarios are created by the Mx8000 software development engineers and are resident on the CD used to upgrade scanner software. When the CT scanner software is upgraded, the scenario files are copied to the Host computer, after which CANpro downloads and encrypts them for you during initialization. Un-encrypted scenarios cannot be executed from CANpro in Field Service Mode.

NOTE:

To achieve acceptable real time behavior, do not run other applications in parallel to CANpro while CANpro is monitoring or simulating telegrams.

CAN Monitoring and CAN Simulation may be executed simultaneously. The protocol file then contains telegrams read from the CAN bus and also from simulated telegrams. This is very useful to document executed tests and find the cause for errors. When CANpro is used to execute scans, a *“Thermal Load Calculator (Heat Calculator, TLC)”* is used to make sure that the x-ray tube is not damaged.

You can read a description of the scenario file before loading it using the "Description"-Button in the Simulation Load dialog. Execute the scenario if you are sure you have loaded the correct scenario.

Loading and Checking Scenario Files

Syntactic and semantic checking of the scenario file prior to usage is achieved by the menu command **Simulation Load**. Commands and control structures are converted into ready-to-run internal structures when the scenario file is loaded.

Syntax Checking

Syntax errors in the scenario language generate an error message box containing the following information:

- Cause of the error
- Location of the incorrect syntax

Scenarios with syntax errors cannot be executed. Attempting to load a scenario with syntax errors results in the following:

- Loading is stopped
- Affected scenario file is presented in an edit window
- Line containing the token causing the error is highlighted

Semantics Checking

CANpro displays a warning in a message box if you attempt to load a scenario that contains CAN command names, parameter labels and CAN identifiers not defined for the current machine. Loading is not stopped and the warning is suppressed during simulation.

Scenario File Execution

General Requirements for Simulation

Make sure that CANpro is running exclusively on the PC with no other Windows or DOS applications active and the following conditions are met before starting a simulation scenario:

- The PC is equipped with a CAN card.
- The CAN driver must be online. Look at the CAN driver field in CANpro's status bar (see *Figure 13-9*).
- The CAN parameters must be the same that are used on the CAN bus you are evaluating (normal case with nothing changed).

NOTE:

Before starting scans with x-ray, read about the *"Thermal Load Calculator (Heat Calculator, TLC)"*.

To achieve acceptable real time behavior, do not run other applications in parallel to CANpro while CANpro is monitoring or simulating telegrams.

The loaded simulation is started by the menu command **Simulation Start** <sim_name>. Make sure :

- The general requirements for simulation are met before starting.
- The name of the loaded scenario file is displayed on the menu item.

The simulation running dialog that contains the Abort Scenario button is displayed. If you press this button, the running simulation scenario is aborted, but the scenario remains loaded.

Scenario calls are added to the protocol file if the "Print Scenario Calls into Protocol File" option under **Options | Simulation** is set and the monitor is running.

CAN Parameters

The baud rate used for sending and receiving telegrams is set in the Bus Timing Registers **BTR0** and **BTR1**. For the hexadecimal values corresponding to the different baud rates, see the documentation of your CAN card.

You should change the CAN parameters only if the new parameters harmonize with those used on the CAN bus you are evaluating. This may be the case if no telegrams can be monitored and everything else (CAN card OK, physical connections exist, monitor ON) seems to be all right.

Simulation Options Dialog Box

NOTE:

Current simulation options are user-specific and are saved at the end of CANpro execution.

Specify the following options with this dialog box:

- **Print Scenario Calls into Protocol File**
  Scenario calls are inserted into the protocol file if the monitor is ON during simulation when this option is checked. This option is useful if you are developing and testing test scenarios.

WARNING

THE ABORT SCAN AND GANTRY MOVEMENTS WHEN ABORTING SCENARIO CHECKBOX MUST BE SELECTED AT ALL TIMES.

- **Abort Scan and Gantry Movements when Aborting Scenario**
  The test scenario is aborted and the CAN command (CS) is sent to the gantry to stop the current scan every time the Abort Scenario button is pressed and this option is selected.

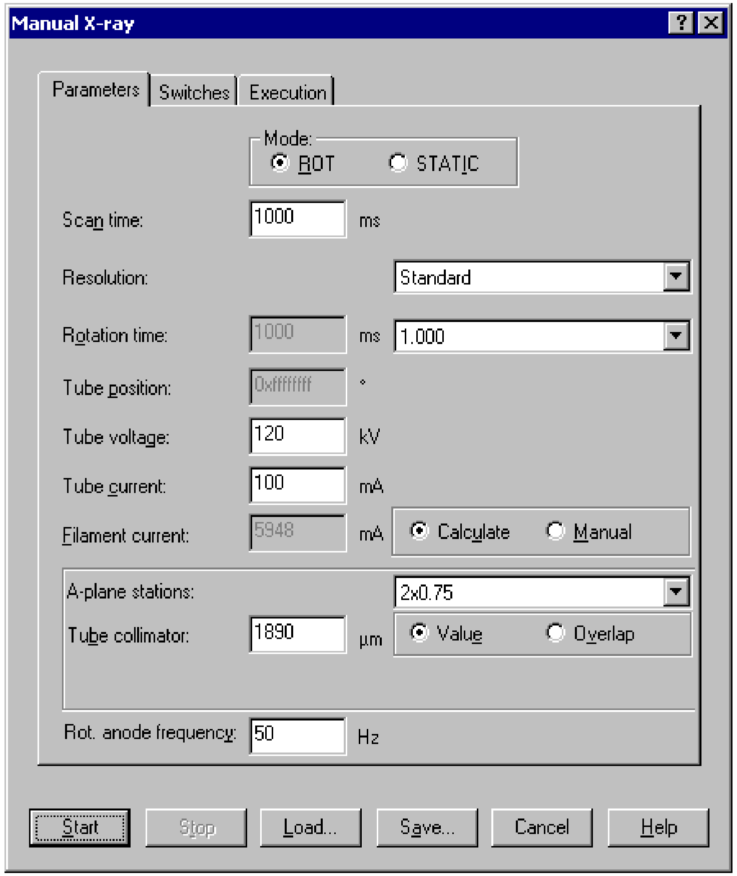
Manual X-ray Dialog

This dialog allows the configuration of the most important mode table parameters related to X-ray generation, collimator motion, and gantry rotation.

Set the parameter values in the Parameters dialog box (see *Figure 13-11*).

The mode and cycle tables consist of two modes in total:

- A pre-measurement
- A ROT mode or STATIC mode



Mode: ● ROT ○ STATIC

Scan time: 1000 ms

Resolution: Standard

Rotation time: 1000 ms 1.000

Tube position: 0xffffffff °

Tube voltage: 120 kV

Tube current: 100 mA

Filament current: 5948 mA ● Calculate ○ Manual

A-plane stations: 2x0.75

Tube collimator: 1890 µm ● Value ○ Overlap

Rot. anode frequency: 50 Hz

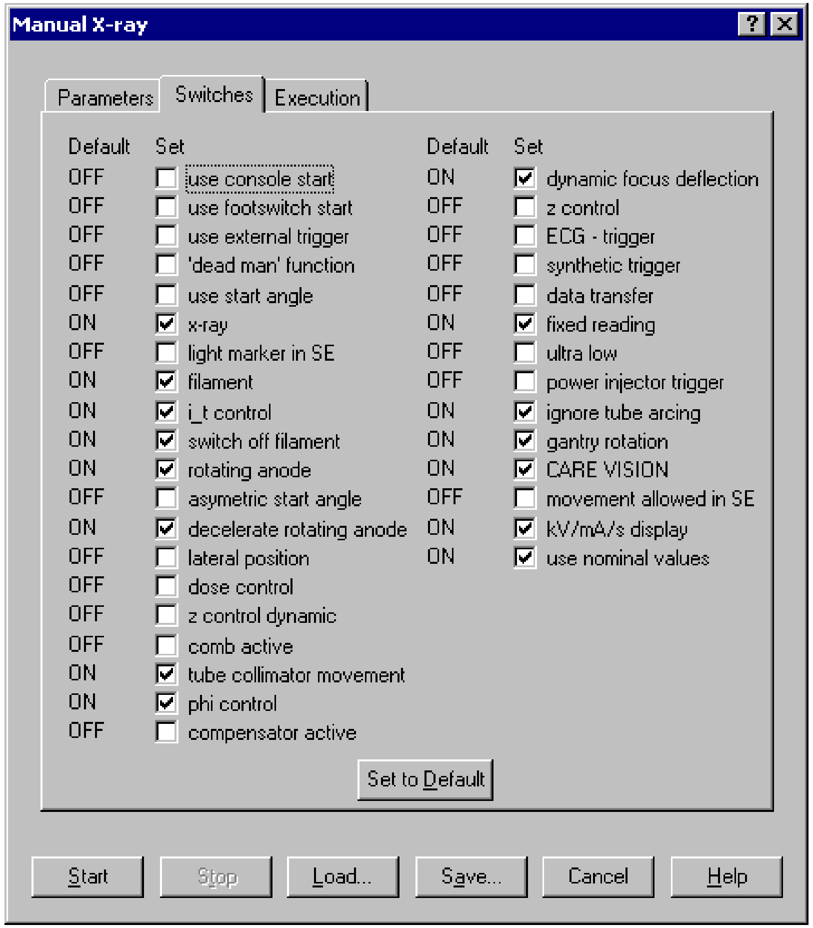
Figure 13-11: Manual X-ray Parameters Dialog Box

WARNING

WHEN PERFORMING A STATIC SCAN, THE ROTOR ROTATES TO THE REQUESTED TUBE BEFORE INITIATING THE SCAN.

Set the parameter values in the Switches dialog box (see *Figure 13-12*).

It allows each of the switch bit fields of TF0 to be disabled (force to 0), enabled (set to 1), or not alter (use the defined value generated automatically).



Default	Set	
OFF	☐	use console start
OFF	☐	use footswitch start
OFF	☐	use external trigger
OFF	☐	'dead man' function
OFF	☐	use start angle
ON	☑	x-ray
OFF	☐	light marker in SE
ON	☑	filament
ON	☑	i_t control
ON	☑	switch off filament
ON	☑	rotating anode
OFF	☐	asymetric start angle
ON	☑	decelerate rotating anode
OFF	☐	lateral position
OFF	☐	dose control
OFF	☐	z control dynamic
OFF	☐	comb active
ON	☑	tube collimator movement
ON	☑	phi control
OFF	☐	compensator active

Default	Set	
ON	☑	dynamic focus deflection
OFF	☐	z control
OFF	☐	ECG - trigger
OFF	☐	synthetic trigger
OFF	☐	data transfer
ON	☑	fixed reading
OFF	☐	ultra low
OFF	☐	power injector trigger
ON	☑	ignore tube arcing
ON	☑	gantry rotation
ON	☑	CARE VISION
OFF	☐	movement allowed in SE
ON	☑	kV/mA/s display
ON	☑	use nominal values

Figure 13-12: Manual X-ray Switches Dialog Box

⚠ CAUTION

IF YOU SET "X-RAY" ON, "ROTATING ANODE" MUST ALSO BE ON. OTHERWISE, THE TUBE WILL BE DAMAGED. FOR FIELD SERVICE USERS, THIS IS ADAPTED AUTOMATICALLY BY CANPRO.

NOT ALL POSSIBLE COMBINATIONS ARE ALLOWED. YOU CAN DAMAGE THE SCANNER MACHINE IF YOU DO NOT KNOW EXACTLY WHAT YOU ARE DOING.

⚠ CAUTION

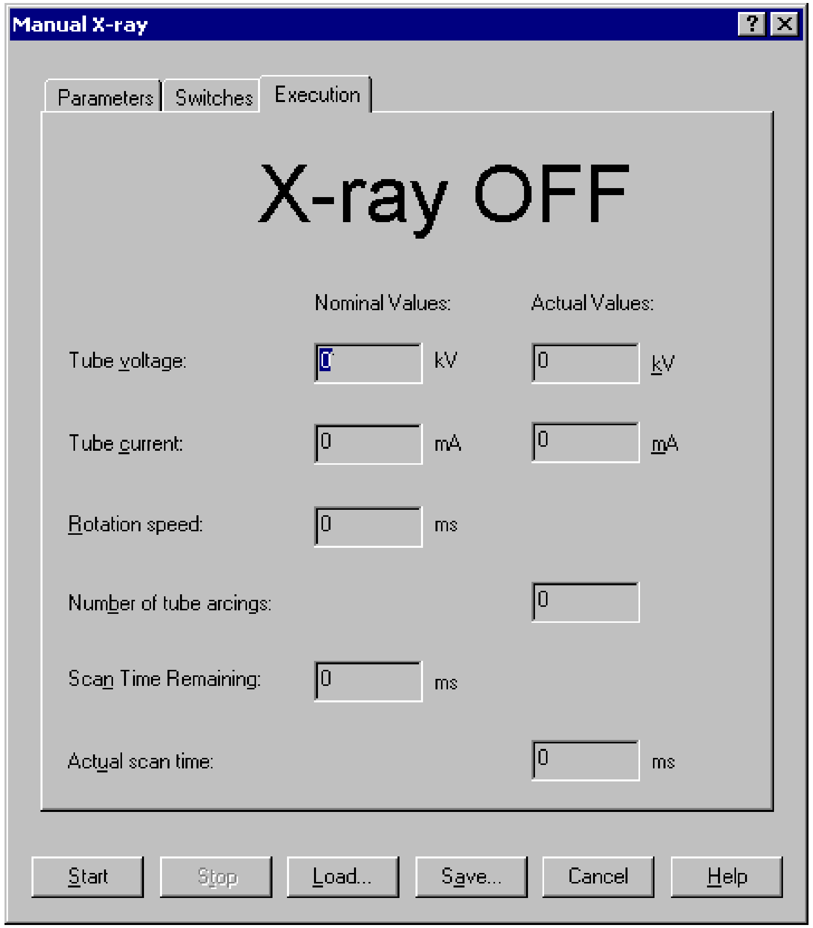
FOR MX8000 IDT SCANNERS:

A dummy TLC is used in the host software version 2.0. There is an automatic delay between scans to protect the X-ray tube. The following message appears:
"An Automatic Delay of 2 minutes is activated with each scan to protect the X-ray tube. If you run X-ray scans of longer than 50 seconds, wait at least five minutes between scans." After running an X-ray scan of 50 seconds from the CANpro, wait at least ten minutes before running a similar scan from the host.

Click **Start** to display the Execution window (see *Figure 13-13*).

- A scan with the previously chosen values is executed.
- You cannot alter the parameters and switches anymore.
- Actual values of some parameters are displayed as they are received from the scanner machine.

You have the option to save the settings for a given test under a unique name that may be recalled later while working on other machines. These files are called Manual X-ray files (*.xray).



Manual X-ray

X-ray OFF

	Nominal Values:		Actual Values:	
Tube voltage:	0	kV	0	kV
Tube current:	0	mA	0	mA
Rotation speed:	0	ms		
Number of tube arcings:			0	
Scan Time Remaining:	0	ms		
Actual scan time:			0	ms

Figure 13-13: Manual X-ray Execution Window

CANpro User Tips

Evaluating Protocol Files on a PC without any CAN Card

A protocol file is a simple (but large) text file. In most cases the easiest way is to print your protocols directly from CANpro.

Having the CAN Card installed on your PC is not required for viewing and printing protocols. CANpro will inform you in its initialization phase that it is "offline". This means that monitoring and simulation cannot be started. However, you can open your files, review them and print the pages or select the lines you want to print.

Performing Long-Term Monitoring during One or more Weeks

Freeing Disk Space

For long-term monitoring, a lot of disk space is needed. Prepare the computer as follows:

1. Reboot the computer to reallocate system resources used by other applications but not freed up after the application is closed.
2. Delete any unnecessary files to free as much disk space as possible.

NOTE:

To achieve acceptable real time behavior, do not run other applications in parallel to CANpro while CANpro is monitoring, Flash Loading or during Simulation. For the same reason, you should not use a screen saver.

3. Turn off the screen until you return.

Preparing the CANpro

1. Select or enter a proper machine name for the scanner machine you are connected to. CANpro downloads the necessary files for you.
2. Open a protocol file with menu File New Protocol (**CTRL+N**), and start monitoring with Monitor Start. Test if the CAN parameters are correct and you receive telegrams from the tested machine.
3. Stop the monitor.
4. Look at the options for telegram interpretation. The selected option for commands and tables should normally be **none**, since explicitly interpreted telegrams create several lines of text instead of one. However, there may be cases when you want to select a few commands or tables to be explicitly interpreted.
5. Look at the options for telegram filtering. Leave out telegrams with IDs you are absolutely not interested in (by default, SLIO telegrams are left out). You can filter any telegrams out that you want, since the background protocol will still store all telegrams.
6. Start monitoring.

Continuing a Sequence of Autonumbered Protocol Files

CANpro generally adds eight zero digits to the protocol file name you selected, and goes on numbering the files as they are full. So if you say File New Protocol (**CTRL+N**) giving as name "Testcase115a-on-TX17-by-Mary" or "Testcase115a-on-TX17-by-Mary.cpf", the first protocol file will be named "Testcase115a-on-TX17-by-Mary-00000000.cpf", the next "Testcase115a-on-TX17-by-Mary-00000001.cpf", and so on.

Sometimes, you have closed the current protocol file or you have left CANpro for some reason, but afterwards you want to go on numbering with the same file name:

You create a protocol file with menu File New Protocol (**CTRL+N**), giving it the same name as before:

Either without number and extension: "Testcase115a-on-TX17-by-Mary", or you choose one of the already existing protocol file names with the same naming scheme: "Testcase115a-on-TX17-by-Mary-00000017.cpf".

Then, CANpro notes that there are already some files with the same naming scheme, so it offers a dialog in which you can choose if you want to go on counting or overwrite the numbered files with this name. You choose "go on counting" and get the file name with the first number that does still not exist.

Flash Load and Read

NOTE:

Do not run other applications in parallel to CANpro while Flash Loading or Reading.

Load binary files to and read from the flash PROM of the CT scanner machine. This is used for updating the scanner machine's firmware program. Flash Loading and Monitoring can be executed at the same time. The protocol file then contains telegrams read from CAN bus and the flash telegrams sent by CANpro.

Flash Loading or Reading is possible in the following scanner machine states:

- STOP
- INIT_DONE
- HALT
- TABLE_LOAD

Load the controllers' firmware and parameters stored in binary files via CAN bus into the controllers' flash PROM. It is now easy to choose a firmware version matching the hardware revision of the controller.

Read the controllers' firmware and parameters from the controllers' flash PROM and store them into a binary file.

Loading Firmware to the Gantry

Overview

In the menu command **Flash | Load**, CANpro uses a file "firmware_lookup.cfg" in the firmware directory of the standard machine description Mx8000 / Mx8000IDT to look up for each hardware component (for example, "ACU" or "GPC") a list of hardware / software revisions and matching firmware versions.

To update only one controller, choose an available firmware version with the Firmware Configuration Tool:

- Use the menu command **Flash | Load**.
- CANpro switches all controllers into Flash mode by sending Flash Start (FS).
- You can specify the file name, the type of file (firmware, parameter block 1 or 2) and the controller. If you load firmware, the Firmware Configuration Tool is used to select a matching firmware file.
- CANpro sends Flash Clear (FC) with the selected controller number.
- Then it sends the firmware block by block to the Master, starting with Flash Block (FB) and waiting for Flash Verified (FV) after the block.
- Afterwards, it asks you if it shall go on loading. If you select "No", CANpro sends Flash Done (FD) to all controllers, and then Init Start (IS) to get the machine into an operable state again.
- If any block is not confirmed in the predefined time, CANpro asks the user if the block shall be repeated.

After loading a firmware to flash PROM of a controller, the file "gantry_hardware_firmware.cfg" of this particular scanner machine is automatically being updated by CANpro and uploaded to the host of the scanner machine. There is a new menu option Flash -> Load Complete Configuration that allows you to use an existing file "gantry_hardware_firmware*.cfg" to update all firmware components at once. It can be the one of a different machine, or a standard file stored in any directory.

Flash Load Procedure

Use this menu command to load firmware and parameters stored in binary files via CAN bus into the controllers' flash PROM. Flash Loading is possible in the following scanner machine states:

- STOP
- INIT_DONE
- HALT
- TABLE_LOAD

Perform the Flash Load procedure as follows:

1. From the **Flash** menu, select **Load**. The Flash Load dialog box appears (see *Figure 13-14*).
2. Select both the desired controller from the Controller list and the **Firmware** option. Click **Select File**. The Selected Controller dialog box appears (see *Figure 13-15*).

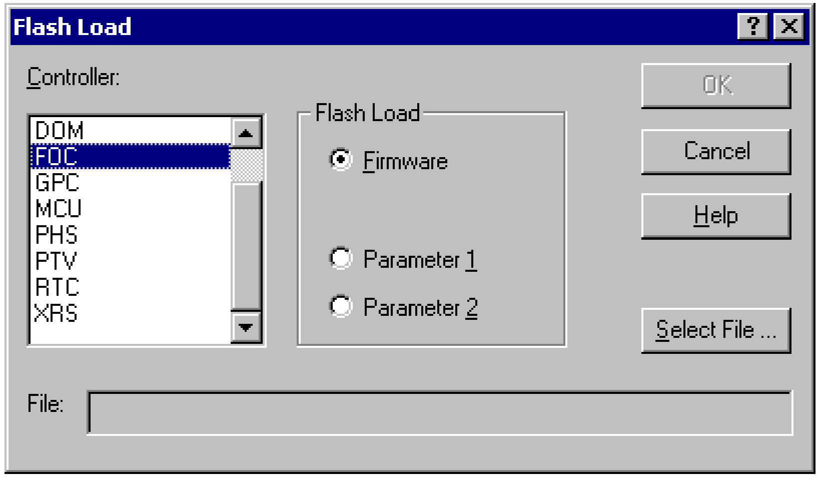

Flash Load
?
✕
Controller:
DOM
FOC
GPC
MCU
PHS
PTV
RTC
XRS
Flash Load
● Firmware
○ Parameter 1
○ Parameter 2
OK
Cancel
Help
Select File ...
File:

Figure 13-14: Flash Load Dialog Box

3. A list of Hardware / Software Revisions appears for the component chosen in Step 2. Select the relevant version from the list.
4. Select the matching firmware version from the Available Firmware Versions list and click **OK**. The firmware is loaded onto the controller.

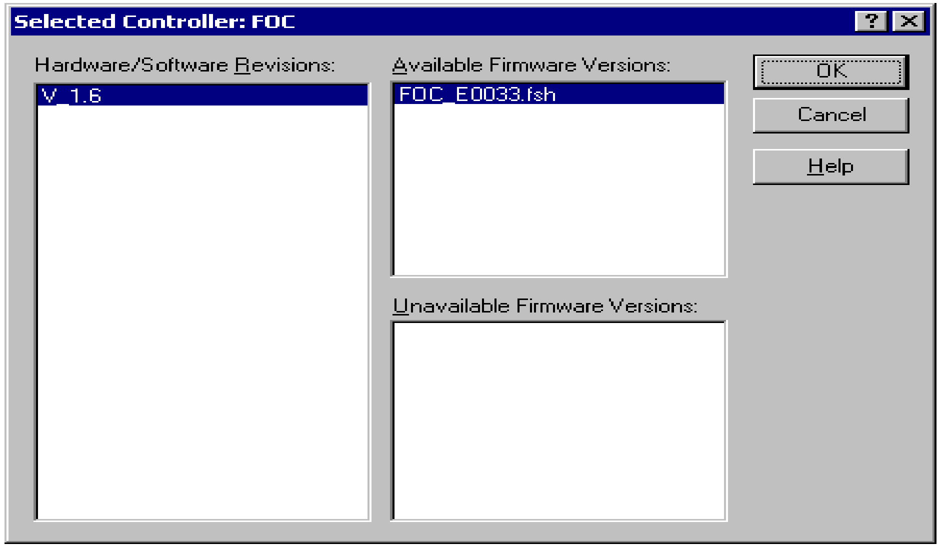

Selected Controller: FOC
?
✕
Hardware/Software Revisions:
V_1.6
Available Firmware Versions:
FOC_E0033.fsh
Unavailable Firmware Versions:
OK
Cancel
Help

Figure 13-15: Selected Controller Dialog Box

NOTE:

CANpro uses a file "**firmware_lookup.cfg**" from the firmware directory of the standard machine description **Mx8000 / Mx8000IDT** to look up and offer the possible choices. If any firmware versions appear in the Unavailable Firmware Versions list, these files need to be installed to your PC using the **Firmware Setup Tool**, before you can load them. After loading, the file "**gantry_hardware_firmware.cfg**" of this particular scanner machine is being updated and uploaded to the host of the scanner machine. In this way, the current hardware/firmware configuration is always stored completely on the host - provided that the CANpro-host connection has been established

Loading Complete Configuration

This menu option allows you to use an existing "gantry_hardware_firmware*.cfg" file to update all firmware components at once. In this way, you can copy a hardware/firmware configuration from one machine to the other:

- A dialog is opened where you select which "gantry_hardware_firmware*.cfg" file is used as input.
- You can select the "gantry_hardware_firmware.cfg" file of a different machine with the same hardware configuration, or a standard file in a different directory.

CANpro reads that file and checks if all firmware files needed are found in the corresponding directories as follows:
For Mx8000—%machines%/Mx8000/firmware/<controller> directories
For Mx8000 IDT—%machines%/Mx8000IDT/firmware/<controller> directories

After CANpro has successfully loaded the firmware files to the flash PROM of each controller, the new "gantry_hardware_firmware.cfg" file is stored in the machine's firmware directory and uploaded to the host of the scanner machine.

Reading Firmware from the Gantry

Overview

Flash Reading is possible in the following scanner machine states:

- STOP (from STANDBY: press STOP button)
- INIT_DONE (switch machine on, when it is OFF)
- HALT (especially when a firmware has not been loaded completely, machine will get into HALT after trying to INIT it)
- TABLE_LOAD

To read a firmware file or parameter block from flash PROM and store it in a binary file:

- Use the menu command **Flash | Read**.
- CANpro switches all controllers into Flash mode by sending Flash Start (FS).

- You can specify the file name, the type of file (firmware, parameter block 1 or 2), the number of blocks (1 to 52 depending on firmware length), and the controller. If you know the length of the firmware, specify the block number. If you don’t, leave the default value which is the maximum length.
- CANpro sends Flash Read with the selected controller number and the first block number.
- It waits for the whole block to be received and writes it into the file.
- After receiving all blocks, it asks you if it shall go on reading. If you select "No", CANpro sends Flash Done (FD) to all controllers, and then Init Start (IS) to get the machine into an operable state again.
- If any block is not sent in the predefined time, or a fragment is damaged, or a fragment is missing, CANpro asks the user if the block shall be repeated.

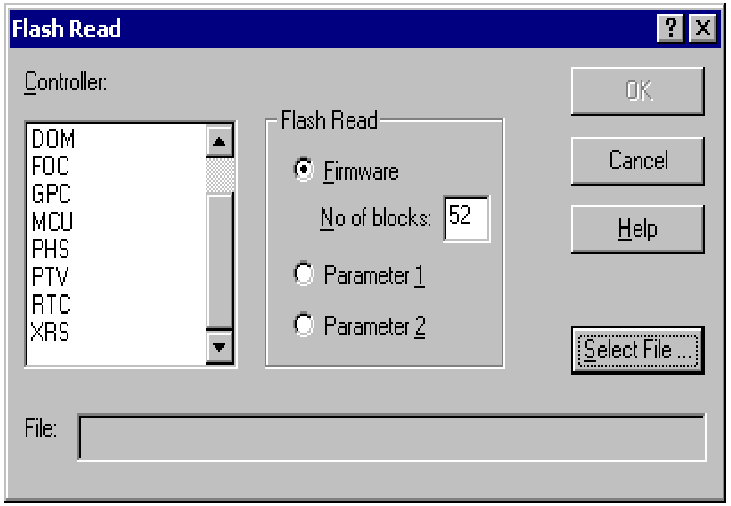
Flash Read Procedure

Use this menu command to read a firmware file or parameter block from flash PROM and store it in a binary file. Flash Reading is possible in the following scanner machine states:

- STOP
- INIT_DONE
- HALT
- TABLE_LOAD

Perform the Flash Read procedure as follows:

1. From the **Flash** menu, select **Read**. The Flash Read dialog box appears (see *Figure 13-16*).
2. Select both the desired controller from the Controller list and the **Firmware** option. Click **Select File**. The Selected Controller dialog box appears (see *Figure 13-17*).


Flash Read
Controller:
DOM
FOC
GPC
MCU
PHS
PTV
RTC
XRS
Flash Read
● Firmware
○ Parameter 1
○ Parameter 2
OK
Cancel
Help
Select File ...
File:

No of blocks: 52

Figure 13-16: Flash Read Dialog Box

3. A list of Hardware / Software Revisions appears for the component chosen in Step 2. Select the relevant version from the list.
4. Select the matching firmware version from the Available Firmware Versions list and click **OK**.
5. Save flash firmware files with any kind of extension. The standard flash file extension is ".fsh".

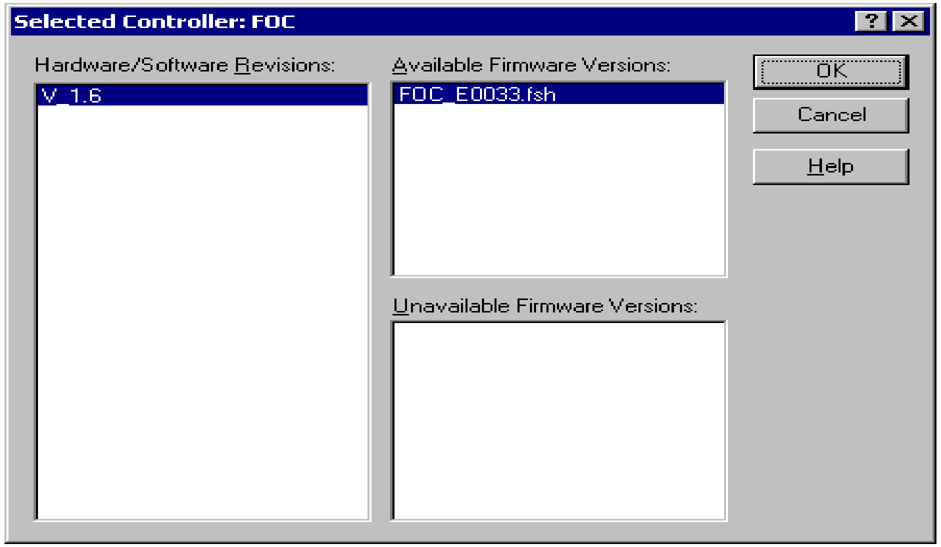

Selected Controller: FOC
?
Hardware/Software Revisions:
V_1.6
Available Firmware Versions:
FOC_E0033.fsh
Unavailable Firmware Versions:
OK
Cancel
Help

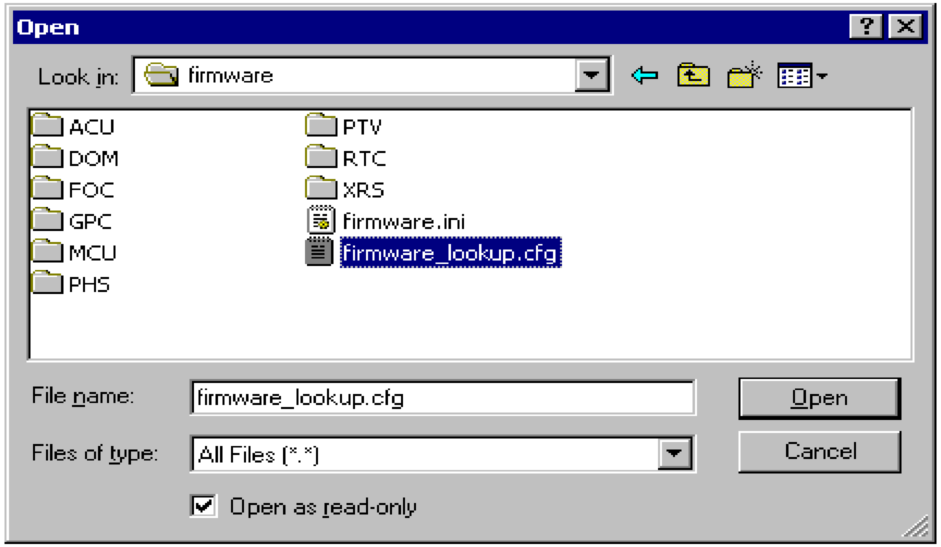
Figure 13-17: Selected Controller Dialog Box

Updating CANpro with Firmware Versions

Periodically you will get a firmware setup CD-ROM or any other medium for updating the firmware files and the firmware lookup configuration file (**firmware_lookup.cfg**) on your CANpro PC. Execute the setup program from the medium on which you received it. New firmware files and an updated "**firmware_lookup.cfg**" file are copied to the correct path where CANpro expects to find them - the firmware directory of the standard machine description Mx8000 / Mx8000IDT. This helps you to keep the Firmware Configuration Tool for menu command **Flash | Load** up-to-date.

Update firmware versions as follows:

1. Run the file **firmwaresetup.exe** from the CD.
2. A firmware folder containing the updated "**firmware_lookup.cfg**" and subfolders with firmware files for each controller is created (see *Figure 13-18*).



Look in: firmware

File name: firmware_lookup.cfg

Files of type: All Files (*.*)

☑ Open as read-only

Figure 13-18: Firmware Setup

Updating CANpro with Additional Error Documents

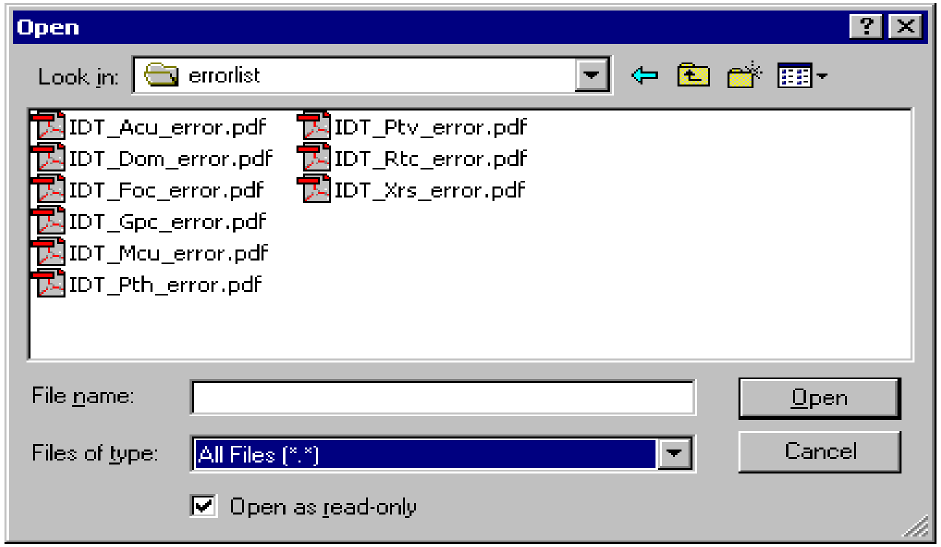
During the first time installation of the CANpro, the following two shortcut icons are created on the laptop desktop:

- Mx8000 Errorlist (the files are in .doc format)
- Mx8000IDT Errorlist (the files are in .pdf format)

Execute the setup program **errorlistsetup.exe** from where it is. It copies the new error documents to the correct path: the **errorlist** directory of the standard machine description **Mx8000IDT**. Access them there via the desktop icon, as well as directly from your Acrobat Reader application.

Update error documents as follows:

1. Run the file **errorlistsetup.exe** from the CD.
2. An errorlist folder containing the updated error files for each controller is created (see *Figure 13-19*).



Look in: errorlist

IDT_Acu_error.pdf
IDT_Dom_error.pdf
IDT_Foc_error.pdf
IDT_Gpc_error.pdf
IDT_Mcu_error.pdf
IDT_Pth_error.pdf
IDT_Ptv_error.pdf
IDT_Rtc_error.pdf
IDT_Xrs_error.pdf

File name:

Files of type: All Files (*.*)

☑ Open as read-only

Figure 13-19: Errorlist Setup

Troubleshooting

Initialization Errors

Registry Errors

- If the CANpro entries in the Registry cannot be found at all, this is a fatal error.
- CANpro tries to reconstruct keys and values in case of wrong or improbable Registry entries, which can happen if the Registry is edited directly. **Do not directly edit the registry**.

In many cases it is best to install CANpro anew. Follow the instructions in the CANpro installation manual.

CAN Card or Driver Errors

If an error happens during the initialization of the CAN card and driver, or there is no driver installed, CANpro will be in the "offline" state. This means, that no CANpro functions, neither monitoring, simulation, nor flash loading are possible. However, files may be opened, edited and printed. Protocol files can be looked at and telegram lines may be double-clicked for further interpretation.

- If the PEAK CAN driver is found, but the hardware has been removed (e.g., the Peak CAN Dongle has been removed from the parallel interface), you will find the state "driver". You can do everything mentioned above, and additionally you can execute the test scenarios (Simulation, Monitoring) to find out if they work well.
- If you expected to have a hardware installed and you want to monitor or execute tests, you may have to re-install the hardware depending on the actual error message.
- If the PEAK CAN Dongle has been removed and you want to use it again, it may be sufficient to terminate Windows, shut off the computer, connect the PEAK CAN Dongle to the parallel port and to the PS/2 (or DIN) port and restart Windows.

Clicking the symbol "CAN-Hardware" in the system control panel will display a dialog box containing all installed hardware with associated stored values. If the Peak Dongle-Can EPP driver is not present, select it from the hardware list, enter the used parallel port's start address and interrupt (in most cases 378h and 7 for LPT1) and add it to the hardware list.

Machine Description File Errors

Normally, the description files contained in a machine description have been developed and tested before distributing them, so no syntax errors are expected. **If you are a normal developer or service user, do not edit the description files yourself**. If you have edited them by accident:

- Try to use the default machine “**Mx8000**” / "**Mx8000 IDT**" if you are downloading from host or from an external source.
- Reinstall the default machine description "**Mx8000**” / "**Mx8000 IDT**" if that is what you are using. Follow the instructions in the **CANpro installation manual**, using the **CANpro** setup program.

However, if you are the person who writes the description files for a new project, you may get a message that there is a syntax error, describing the exact location with file, line and token where the error was found.

Normally, the effect of this is that this particular file is not loaded; hence this CAN command, table or error list cannot be interpreted. The CAN command list and the identifier list are two exceptions to this rule because neither interpretation of telegrams nor scenario semantics checking is possible for these files. Therefore, these two files cause a fatal error if they contain syntax errors.

The following are used to avoid damages to the X-ray tube:

- Thermal Load Calculator
- TAB_Tf0.dsc
- Other particular table and command description files (some can cause a fatal error in machine loading, since these files need to be present and contain the exact parameter names and types that are expected there, to be able to evaluate the sent and received telegrams).

See the CANpro Installation manual for more information on writing a new machine description and correcting errors in description files. You can select an existing machine or the default "Mx8000" / "Mx8000 IDT" description if you are not able to download the files. If you do not download the needed files from the scanner machine's host, then you are not allowed to use an X-ray with this machine. This is a safety precaution to protect the machine from damages caused by mismatching files.

MCU Filament File Error

CANpro tries to use the default MCU filament file if the MCU filament file has not been found in the CANpro directory on the host. MCU filament current correction is not possible if this file is also not found. Nevertheless, the machine can be loaded; only the menu option Simulation/Load with filament correction is disabled.

Lack of Main Memory

If CANpro reports lack of main memory during initialization, close other applications before starting CANpro. Remember that CANpro needs a good quantity of extra memory so the system does not get into rapid page swapping, what would cause a fatal degradation of execution speed.

Close all other Windows and MS-DOS applications. If the problem still remains, some application has not properly freed all its global memory. Try starting Windows again.

Before doing this, check the size limits of the **paging file**: we recommend at least 125 MB as minimum paging file size, especially when the PC has got only 64 MB RAM (Not selectable for Windows98).

If it is not possible to solve this problem, some memory chips may be damaged.

Host Connection Errors

At CANpro start, it attempts to make two kinds of connections to the host:

- FTP files download
- Socket connection for logging of CANpro activity on the host, time synchronization, as well as for Thermal Load Calculator usage

Error Message when Exiting CANpro or Changing the Machine while a Scan is Running

If a scan is running that:

- Has been originated by CANpro
- CANpro has sent mode table and cycle table information to the gantry
- The scan is started by the start command ("**SE**")

CANpro has stored information about the scan(s) being executed in order to update the Thermal Load Calculator with telegrams returned by the gantry for each scan. This is the way the TLC can always calculate current tube temperature and avoid tube damage. If you stop execution of CANpro during scans while they are being executed, there are still updating telegrams missing. Therefore, you get an error message. You can choose either:

- Go on changing the machine or executing CANpro **-** then cancel messages are being sent to the gantry to stop all running scans.
- Wait until the current scan has finished and the TLC is properly updated.

CANpro Cannot Send or Receive Telegrams

You start CANpro, everything seems to be okay, but you do not see any telegrams displayed. What's wrong? Try this:

- Check that Can Monitoring is ON (see status bar, "MON").
- Check that the CAN driver is not "offline" (see status bar, "offline" instead of "online"). You should have seen an error message during initialization.
- Check that the CAN card installed on your PC is really there. You should have seen an error message during initialization if that was not the case. If the PEAK CAN driver is used, you find "driver" in the status line if CANpro has found a driver but no hardware.
- Check that there is a CAN cable connecting the CAN card of CANpro with the machine you are testing.
- Do a Reset Card to reset the CAN card or CAN dongle, especially if the CAN cable has recently been connected.
- Try to send a telegram with the Menu Simulation/SendATelegram command.
- Check the CAN cable. If it has not been used before, it may not be properly connected. Otherwise, it may be broken. If the cable is missing or broken, you may find the system comment "!! CAN Driver: a bus error occurred." in the protocol file.

- Check that the CAN parameters are correct. If the baud rate is not the same for machine and CANpro, you cannot receive any telegrams. An indication for a wrong baud rate is the system comment "!! CAN Driver: a bus error occurred."
- Depending on CAN cable length, you may need a terminating resistance on one end or on both sides.

If you are simulating without monitoring, start CAN monitoring and make the same checks. If you are trying to load the flash PROM, change to CAN monitoring and make the same checks.

Memory Problems

If CANpro reports lack of main memory during execution, there may be too many files open, especially too many old protocol files opened in "read only". Close them!

You may not have closed other applications. Close them! Remember that CANpro needs a good quantity of extra memory so the system does not get into rapid page swapping, what would cause a fatal degradation of execution speed.

Disk Space Problems

If you open a new protocol file and there is not enough disk space left to store a completely full protocol, an error message is given. Try to find obsolete files and remove them from disk before going on testing.

CAN Driver or Card Errors

If the CAN card is not installed, if it fails or the CAN driver is not properly installed, this will be noticed and reported to you during initialization. There are only errors in relation to bus overload and driver overload you may receive during monitoring and simulation.

Receive queue overrun

CANpro does not read the telegrams as fast as they arrive. Possible causes:

- There are other applications running on the PC.
- The PC's processor frequency is too slow for the baud rate used.

- CANpro itself is sending too many telegrams with too few pauses (this can happen only if there are a lot of telegrams arriving from the CAN bus and at the same time CANpro itself is constantly sending at full speed).

If you are doing Flash Loading or Flash Reading, and CANpro is monitoring at the same time, this error can occur if the PC is not very fast. If you stop the monitor, the error should disappear.

Transmit queue overrun

The telegrams sent by CANpro are not transmitted to the CAN bus, or not so fast as CANpro sends. Possible causes:

- CANpro itself is sending too many telegrams with too few pauses, in comparison with the baud rate used.

Bus error

The CAN card reports a bus error. Possible causes:

- A reset of the hardware (bus error reported only once, not important).
- The baud rates on the CAN cards of some participants on the CAN bus do not match. In this case, no telegrams are received from the CAN bus (see *"CANpro Cannot Send or Receive Telegrams"*).

Hardware overrun

The CAN controller (hardware) sometimes cannot read the telegrams from the CAN bus. Possible causes:

- Under Windows98, on a notebook or PC with a power management installed, the power management may be preventing the CAN driver from properly handling its interrupts. Please uninstall the power management in the system BIOS!
- If there is no power management at all, there may be a different kind of driver conflict, with a driver using the same interrupt as the CAN dongle (== the interrupt that is assigned to the parallel interface you are using for the CAN dongle). Probably you can change in BIOS or in system control the interrupt of the other driver.

Chapter 14
Software Installation

Software Version 2.51 Full Installation 14-1

How This Chapter is Organized 14-2

Software Media 14-4

Installation Procedure Prerequisites 14-4

Installation Procedure General Description 14-7

Mx8000 Software Version 2.51 Installation Using Backup/Restore of System Tables 14-7

Mx8000 Software Version 2.51 Installation Without Using System Tables Backup/Restore 14-8

Note on UNIX IRIX 6.3 Installation Procedure 14-9

System Tables Backup Instructions 14-10

System Tables Backup 14-10

Network Verification (For Systems With External Devices Connected Through a Router) 14-11

UNIX IRIX 6.3 Operating System Installation with Hard Disk Format . 14-12

Hard Disk Format Procedure 14-13

UNIX IRIX 6.3 Operating System Installation After Hard Disk Format 14-16

UNIX IRIX 6.3 Operating System Installation Without Hard Disk Format 14-21

Prior to the UNIX IRIX 6.3 Operating System Installation 14-21

UNIX IRIX 6.3 Operating System Installation 14-25

UNIX IRIX 6.3 Patches Installation 14-28

USP V1.52: Installation Instructions 14-30

Mx8000 Version 2.51: Installation Instructions 14-33

System Tables Restore Instructions 14-34

System Tables Restore 14-34

Verifying Network Settings 14-34

Default Device Storage List 14-35

Hardware Dependant Tables Completion 14-36

System Tables General Description 14-36

P-Plane Collimator Encoder Settings 14-36

WCS and Tilt Motor Type Definition 14-39

System Physical Calibrations and Proper Functioning Check 14-42

System Physical Calibrations 14-42

HIS/RIS Settings Verification (Only for Sites using HIS/RIS) 14-43

Service (IRS) Diagnostic Key Installation 14-44

System Proper Functioning Check 14-44

Mx8000 System Network Configuration 14-45

Final Steps 14-46

System Performance and Image Quality Check 14-46

Version 2.51 System Tables Backup 14-46

License Keys 14-47

Entering an Option License Key (from a printout) 14-47

Verifying the System Options 14-47

Entering Service (IRS) Diagnostic Key 14-47

xfscopy 14-48

Software Version 2.51 Full Installation

Software version 2.51 is the current version for the Mx8000 Quad and Dual scanners. It adds some new options, features, and improvements to the existing application and service packages and fixes known issues of Software version 2.21.

Version 2.51 is common to both the Quad and Dual models of the Mx8000 multi-slice scanners.

The differences between the Quad and Dual models are noted.

The different aspects of this release are elaborated in this chapter.

NOTE:

Perform the procedures described in this chapter only when a **complete new installation** is required. For example, this procedure should be used following a computer hard disk crash, when no recent backup exists.

How This Chapter is Organized

This chapter provides all the information required for the installation of the Mx8000 Dual Software version 2.51.

The following Sections describe:

- *"Software Media"*
  The Software Media necessary for the full installation of the Mx8000 Software version 2.51.
- *"Installation Procedure General Description"*
  General description of the complete Format, UNIX, USP and MX8000 software installation procedures.
  Two scenarios with and without using Backup/Restore of the system tables.
- *"System Tables Backup Instructions"*
  The procedure to save the system 'Gantry dependant' tables and to restore them following the installation of new Mx8000 software
- *"UNIX IRIX 6.3 Operating System Installation with Hard Disk Format"*
  The procedure to install the UNIX IRIX 6.3 Operating System with the O2 computer hard disk format.
- *"UNIX IRIX 6.3 Operating System Installation Without Hard Disk Format"*
  The procedure to install the UNIX IRIX 6.3 operating system without O2 computer hard disk format.
- *"UNIX IRIX 6.3 Patches Installation"*
  The procedure for UNIX IRIX 6.3 Patches installation
- *"USP V1.52: Installation Instructions"*
  The procedure to install the USP V1.52 Software.
- *"Mx8000 Version 2.51: Installation Instructions"*
  The procedure to install the Mx8000 Software version 2.51.
- *"System Tables Restore Instructions"*
  The procedure to restore the system tables.

- *"Hardware Dependant Tables Completion"*

  The procedure to update the hardware dependant tables.
- *"System Physical Calibrations and Proper Functioning Check"*

  System calibrations to be performed after Mx8000 Software Installation without the System Tables restore
- *"Mx8000 System Network Configuration"*

  The Network Configuration procedures.
- *"License Keys"*

  The procedure to install the Option and IRS Diagnostic Licence key from a printout, after completing the Mx8000 Software installation.
- *"xfscopy"*

Software Media

Installation Procedure Prerequisites

Ensure that all required items are present at the site before starting the O2 computer hard disk format, UNIX 6.3 Operating System, USP and the Mx8000 Software Version 2.51 installation procedure.

Mx8000 Software Version 2.51

Table 1: Mx8000 Quad Version 2.51 Software Upgrade Kit P/N 4550 199 13021 (PMSTL P/N 407-7181-9800

ITEM NO.	DESCRIPTION	QTY
1	Mx8000 Upgrade Version 2.51 CD-ROM	1
2	Mx8000 Version 2.51 CD-ROM (complete version)	1
3	Mx8000 Version 2.51 Firmware Tables CD-ROM	1
4	Mx8000 V2.51 FSE Laptop (floppy)	1
5	Software Version 2.51 Upgrade Instructions (this manual)	1
6	Software Version 2.51 Release Notes (for the customer)	1
7	Mx8000 Operation Manual Supplement Release 2.51	1
8	Mx8000 Quad Physics File for V2.51	1
9	Mx8000 Quad CDR File for V2.51	1
10	Customer Letter	1

Table 14-1: Mx8000 Dual Version 2.51 Software Upgrade Kit P/N 4550 199 13031 (PMSTL P/N 407-7182-9700

ITEM NO.	DESCRIPTION	QTY
1	Mx8000 Dual Upgrade Version 2.51 CD-ROM	1
2	Mx8000 Dual Version 2.51 CD-ROM (complete version)	1
3	Mx8000 Version 2.51 Firmware Tables CD-ROM	1
4	Mx8000 V2.51 FSE Laptop (floppy)	1
5	Software Version 2.51 Upgrade Instructions (this manual)	1
6	Software Version 2.51 Release Notes (for the customer)	1
7	Mx8000 Operation Manual Supplement Release 2.51	1
8	Mx8000 Dual Physics File for V2.51	1
9	Mx8000 Dual CDR File for V2.51	1
10	Customer Letter	1

UNIX IRIX 6.3 Operating System Software

Table 14-2: Mx8000 Unix Kit P/N 485-7180-0910

ITEM NO.	PHILIPS P/N	DESCRIPTION	QTY
1	485-7180-0506	IRIX 6.3 for O2 including R10000 (Sequence No. 200)	1
2	485-7180-0605	IRIX 6.3 Applications November 1996 (Sequence No. 201)	1
3	485-7180-2205	IRIX 6.3 Recommended/Required patches (1 of 2) June 1999	1

EOD Cartridge (P/N CP000420016) For System Tables Backup

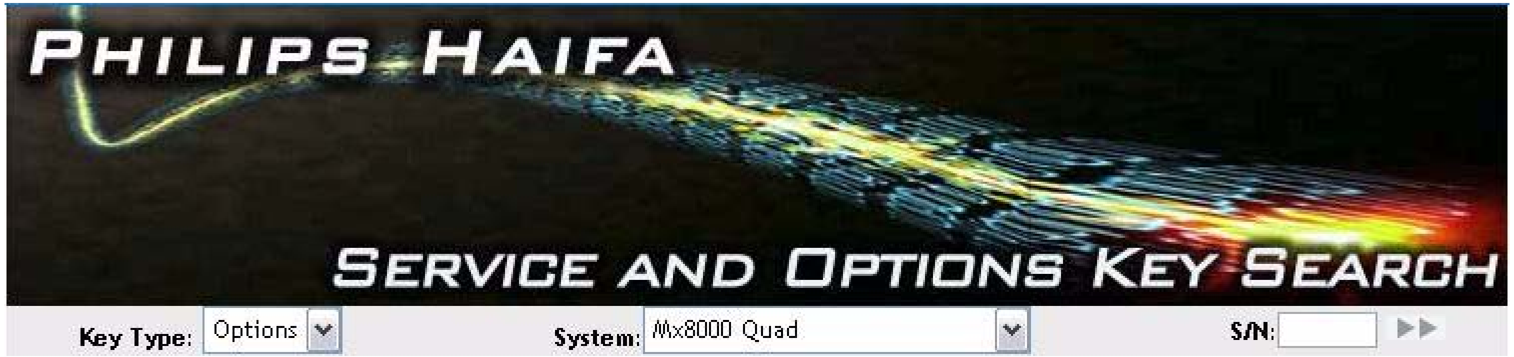
System I.D Verification and Options

1. Login as **root**.
2. Type: **sysinfo – s** and press **<Enter>**.
3. Read the system identifier (176XXXXXXX—Total of ten digits).
4. Verify that the system ID matches the number listed along with the serial number in the Options print-out**.**

Obtain the Version 2.51 Software License key from the Philips Intranet as follows:

a. Enter the URL: *http://intranet.hfa.ms.philips.com/homepage/engineering/Rnd/keySearch*.
The Service and Options Key Search web page appears (see *Figure 14-1*).

b. From the **Key Type** drop-down menu, choose **Options**. From the **System** drop-down menu, choose **Mx8000**. In the **S/N** field, enter the System Serial Number (for example, 3xxx). Then click the right arrows. The License Key data appears.



Key Type: Options
System: Mx8000 Quad

Figure 14-1: Online Software License Key Window

Installation Procedure General Description

There are two possible scenarios to install Mx8000 Software Version 2.51:

- Using System Tables Backup/Restore
- Without using System Tables Backup/Restore

> **NOTE:**
>
> Use only backups that were performed in Version 2.51. Do not use a backup from any previous software versions.

Mx8000 Software Version 2.51 Installation Using Backup/Restore of System Tables

Install Mx8000 Software version 2.51 using System Tables Backup/Restore as follows:

1. Perform the System Tables Backup (see *"System Tables Backup Instructions"*).
2. Install the UNIX IRIX 6.3 Operating System:
    a. With the System Hard Disk Format as a last resort to solve the problem (see *"UNIX IRIX 6.3 Operating System Installation with Hard Disk Format"*).
    b. Without the System Hard Disk Format (see *"UNIX IRIX 6.3 Operating System Installation Without Hard Disk Format"*).
3. Install the USP 1.52 (see *"USP V1.52: Installation Instructions"*).
4. Install the Mx8000 Software version 2.51 (see *"Mx8000 Version 2.51: Installation Instructions"*).
5. Restore System Tables (see *"System Tables Restore Instructions"*).
6. Install Version 2.51 Firmware’s Versions (see *"System Physical Calibrations and Proper Functioning Check"*).
7. Verify the proper functioning of entire system and network devices (see *"Final Steps"*).

Mx8000 Software Version 2.51 Installation Without Using System Tables Backup/Restore

Install the Mx8000 Software version 2.51 without using System Tables Backup/Restore as follows:

1. Install the UNIX IRIX 6.3 Operating System:
    a. With the System Hard Disk Format as a last resort to solve the problem (see *"UNIX IRIX 6.3 Operating System Installation with Hard Disk Format"*).
    b. Without the System Hard Disk Format (see *"UNIX IRIX 6.3 Operating System Installation Without Hard Disk Format"*).
2. Install the USP 1.52 (see *"USP V1.52: Installation Instructions"*).
3. Install the Mx8000 Software version 2.51 (see *"Mx8000 Version 2.51: Installation Instructions"*).
4. Complete the Hardware Dependant Tables (see *"Hardware Dependant Tables Completion"*).
5. Install Version 2.51 Firmware’s Versions (see *"System Physical Calibrations and Proper Functioning Check"*).
6. Configure the Mx8000 System Network (see *"Mx8000 System Network Configuration"*).
7. Perform System Physical Calibrations and Testing (see *"System Physical Calibrations and Proper Functioning Check"*).
8. Verify the proper functioning of entire system and network devices (see *"Final Steps"*).

Note on UNIX IRIX 6.3 Installation Procedure

The installation procedures are different for O2 computers with 200 and 300 MHz processors. To acquire the processor's speed do the following:

1. Login as **root**.
2. Type **hinv** and press **<Enter>.**
3. Look for information about O2 computer processor speed and the memory size.

Use acquired information to choose the appropriate installation procedure when you are asked to proceed to the next action.

System Tables Backup Instructions

System Tables Backup

1. Login as **Mx8000**.
2. Insert formatted EOD cartridge.
3. Select **Service | Save/Restore Tables** in the **System** menu. The **Backup/Restore** window opens.
4. Select the following check boxes in the **Backup/Restore** window:
   - **Backup**
   - select the device **EOD**,
   - select **Select All** for a comprehensive restore.
5. Click **Start Backup**. The backup takes a few minutes.
6. The backup ends when **Done** and **End Backup** are displayed in the **Report window**.
   (This backup is necessary to re-install the current version).

NOTE:

Every additional backup to the EOD does not overwrite the previous backup but creates a new backup directory sorted by date and time.

Proceed to *"Network Verification (For Systems With External Devices Connected Through a Router)"*

Network Verification (For Systems With External Devices Connected Through a Router)

If you have an archive device connected through a router, verify the connection as follows:

1. Login as **root** (password **pkserv99).**
2. In **Toolchest**, select **System | System Manager | Network and Connectivity | Set Up and Start Networking**.
3. Click **Next** twice.
4. Write down the number in **Use Default Netmask**.
5. Click **Cancel.**
6. Select **Modify Networking Settings**.
7. Click **Next** twice**.**
8. Write down the **Default Route IP Address**.
9. Click **Cancel** and logout
   The System Hard Disk Formatting (Low Level Format)

Proceed to *"UNIX IRIX 6.3 Operating System Installation with Hard Disk Format"*.

UNIX IRIX 6.3 Operating System Installation with Hard Disk Format

NOTE:

Ensure that the items listed in *"Installation Procedure Prerequisites"*, are present on the site before starting the O2 computer hard disk format, UNIX 6.3 Operating System installation, USP ver. 1.52 installation, and the Mx8000 Software Version 2.51 installation procedure.

⚠ **CAUTION**

IRS SHOULD BE OFF DURING THE O2 COMPUTER HARD DISK FORMAT, AND THE UNIX 6.3 OPERATING SYSTEM, THE USP AND THE MX8000 SOFTWARE INSTALLATION

O2 COMPUTER SHOULD BE DISCONNECTED FROM THE NETWORK DURING THE O2 COMPUTER HARD DISK FORMAT, AND THE UNIX 6.3 OPERATING SYSTEM, THE USP AND THE MX8000 SOFTWARE INSTALLATION.

Prior to the O2 computer hard disk format perform the following:

1. Logout, and then click **Shutdown** to shutdown the O2 computer.
2. Turn the IRS power OFF.
3. Only if you have a 200 MHz processor, remove memory in excess of 256 MB from the O2 computer.
4. Disconnect the O2 computer from the network.

Proceed to *"Hard Disk Format Procedure"*.

Hard Disk Format Procedure

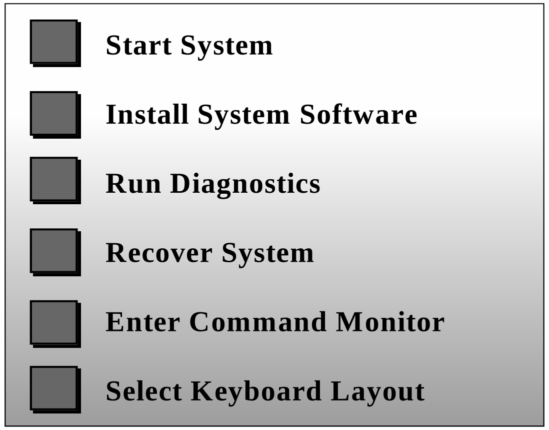
Entering Format Procedure Session

1. Power ON the O2 computer (IRS should be OFF). When the message "The System is starting up**"** appears, click **Stop for Maintenance** or press **<Esc>** immediately to get the appropriate menu.

NOTE:

You have just five seconds to press **<Esc>** before the message disappears and the system starts up. If you fail to do so, wait until the system comes up (the login screen appears). Turn off the system and start again.

The following menu is displayed:


Start System
Install System Software
Run Diagnostics
Recover System
Enter Command Monitor
Select Keyboard Layout

2. Click **Enter Command Monitor**. A window opens and the **>** prompt appears.

3. Insert the **IRIX 6.3 for O2 including R10000** CD-ROM.

Proceed to *"Format Procedure"*.

Format Procedure

1. To perform low level format, at the prompt **>** type:
   boot -f dksc(0,4,8)sashARCS and press **<ENTER>.**
2. When the process pauses and **sash**: is displayed, type:
   boot -f dksc(0,4,7)stand/fx.ARCS --x and press **<ENTER>.**
   - — The middle number should be according to the SCSI ID of the CD-ROM.
   - — Type a double minus sign before the **x**.
3. Press **<ENTER>** *three* times (to confirm the default parameters - **dksc, 0, 1**). The prompt: **fx>** appears.
4. Type: **f** and press **<ENTER>**.
5. Press **<ENTER>** (for current) to continue.
   A warning states that the contents of the disk will be destroyed.
6. At the **O.K.?** prompt, type: **y** and press **<ENTER>**.

NOTE:

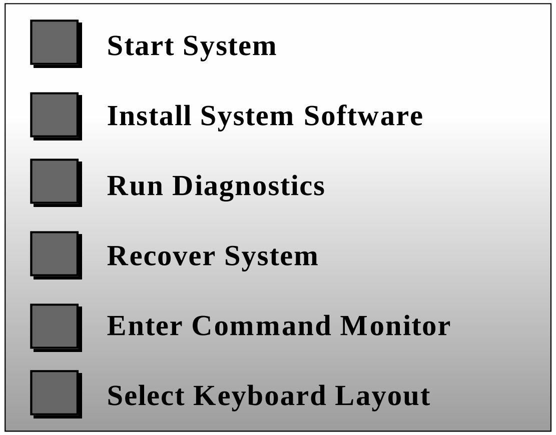
The formatting procedure takes usually up to 15 minutes (unless there are problematic areas on the hard disk and then it can take up to 90 minutes. as it is displayed. During that time the screen is disabled.

When the prompt **fx>** appears again, type: **r** (for repartition) and press **<ENTER>**.
The prompt: **fx/repartition>** appears.

7. Type **ro** and press **<ENTER>** (for root drive).
8. The message "...........type of data partition=(xfs)" appears. Press **<ENTER>** to confirm. **“**….continue?**”** is displayed. Type: **yes (**or **y)** and press **<ENTER>** to continue.

9. At the **fx/repartition>** prompt, type: **. .** (two periods) and press **<ENTER>**.
   Type **l** (for label) and press **<ENTER>**.
10. Type: **c** (for create) and press **<ENTER>**.
11. Type: **a** (for all) and press **<ENTER>**.
12. Type: **. .** (two periods) and press **<ENTER>**.
13. Type: **. .** (two periods) again and press **<ENTER>**.
14. At the **fx>** prompt, type: **exit** and press **<ENTER>** to exit the formatting session.
15. The following message appears: "write out changes? (Yes)". Press **<ENTER>**.

The **fx** program is now completed and, after a delay of few seconds, the **Maintenance Menu** is displayed.


Start System
Install System Software
Run Diagnostics
Recover System
Enter Command Monitor
Select Keyboard Layout

To install the UNIX operating system **after hard disk format,** proceed to *"UNIX IRIX 6.3 Operating System Installation After Hard Disk Format"*.

UNIX IRIX 6.3 Operating System Installation After Hard Disk Format

Install the UNIX IRIX 6.3 Operating System Installation on an O2 Computer (after hard disk format) as follows:

- For 200 MHz speed processor, proceed to *"UNIX IRIX 6.3 Operating System Installation on an O2 Computer with a 200 MHz Processor (after hard disk formatting)"*.
- For 300 MHz speed processor, proceed to *"UNIX IRIX 6.3 Operating System Installation on an O2 Computer with 300 MHz Processors (after hard disk format)"*.

UNIX IRIX 6.3 Operating System Installation on an O2 Computer with a 200 MHz Processor (after hard disk formatting)

Install the **IRIX 6.3 Operating system** as follows**:**

1. Insert the **IRIX 6.3 for O2 including R10000** CD-ROM.
2. From the **Maintenance** menu select **Install System Software**.
3. A screen with possible installation sources opens. Click the default source (**local CD-ROM**).
   *** Local SCSI CD-ROM drive 4** is displayed.
   Click **[install]**.
4. The next window opens; click **[continue]**. The progress window of the initial installation stage **Copying installation tools to disk** opens. This process takes about 2 min. The system reboots after all the files are copied. The following message is displayed: "Make a new file system on /dev/dsk/dks0d1s0 (yes/no)?". Type: **yes** and press **<ENTER>**.
5. When the following message appears: "Are you sure?", type: **y** and press **<ENTER>.**
6. When asked "........[efs/xfs]", type: **xfs** and press **<ENTER>**.
7. When asked "........[512/4096]", type: **4096** and press **<ENTER>**.
8. At the **inst>** prompt, type: **list** and press **<ENTER>**.
9. When asked "........... more?(h=help)", press the **<SPACEBAR>**.
   The following menu appears:
   1. /CDROM/dist/
   2. done (no action)

   Install software from [CDROM/dist]

10. Eject the **IRIX 6.3 for O2 including R10000** CD-ROM and insert the **IRIX 6.3 Applications November 1996** CD-ROM.

> **NOTE:**
>
> During the course of the installation procedure you are prompted to swap CD-ROM's several times. Carefully follow the instructions and pay attention to the order. Generally, when swapping the CD's, the installation program automatically continues after a delay.

11. After waiting a few seconds press **<ENTER>** and then press the **<SPACEBAR>** *twice* when asked "........... more? (h=help)".
12. When the following menu appears:
    1. /CDROM/dist/
    2. done (no action)

    Install software from [CDROM/dist]

    Type: **2** and press **<ENTER>** for done.
13. When the "more? (h=help)" message appears type: **q** (to quit) to exit the list and get the **inst >** prompt.
14. At the **inst >** prompt type: **install eoe.sw.uucp** and press **<ENTER>**.
15. At the **inst >** prompt type: **install eoe.sw.ppp** and press **<ENTER>**.
16. At the **inst >** prompt, type: **go** and press **<ENTER>**.
17. After about 2 min. (at 16% of installation progress) the message "Type control - C to interrupt" appears**.**

    Eject the **IRIX 6.3 Applications November 1996** CD-ROM and insert the **IRIX 6.3 for O2 including R10000** CD-ROM.

    The installation continues automatically after a few seconds. This step takes approximately 7 min.
18. The installation pauses at 54% of installation progress and the following message appears: "Type control - C to interrupt".

    Eject the **IRIX 6.3 for O2 including R10000** CD-ROM and insert the **IRIX 6.3 Applications November 1996** CD-ROM.

The installation continues automatically after a few seconds. This step takes approximately 20 min.

NOTE:

Ignore the error messages if any appear between 96% and 97%. Ignore the message: "errors occurred after ....100% done..."

The **inst >** prompt appears at the end of procedure.

Proceed to *"UNIX IRIX 6.3 Patches Installation"*.

UNIX IRIX 6.3 Operating System Installation on an O2 Computer with 300 MHz Processors (after hard disk format)

Install the UNIX IRIX 6.3 Operating System Installation on an O2 Computer with a 300 MHz Processor (after hard disk format) as follows:

NOTE:

The following commands (steps 1 and 2) override the necessity for the physical removal of memory above 256 MB from the O2 computer.
In case that you have removed any additional memory in excess of 256 MB omit the steps 1 and 2 and proceed to step 3.

1. From the **Maintenance** menu click **Enter Command Monitor**.
2. Type **setenv -p maxpmem 262144** and press **<ENTER>**

   Type **Exit** to close the window and to return to the **Maintenance** menu.
3. Insert the **IRIX 6.3 Recommended/Required patches (1 of 2) June 1999** CD-ROM.

4. From the **Maintenance** menu click **Install System Software**.
5. A screen with possible installation sources opens. Click the default source (**local CD-ROM**).
   *** Local SCSI CD-ROM drive 4** is displayed.
   Click **Install**.
6. The next window opens; click **continue**. The progress window of the initial installation stage **Copying installation tools to disk** opens. This process takes about 2 min. The system reboots after all the files are copied. The following message is displayed: "Make a new file system on /dev/dsk/dks0d1s0 (yes/no)?". Type **yes** and press **<ENTER>**.
7. When the following message appears: "Are you sure?", type **y** and press **<ENTER>**.
8. When asked "........[efs/xfs]", type **xfs** and press **<ENTER>**.
9. When asked: "........[512/4096]", type **4096** and press **<ENTER>**.
10. At the **inst>** prompt, eject the **IRIX 6.3 Recommended/Required patches(1 of 2) June 1999** CD-ROM.
11. Insert the **IRIX 6.3 for O2 including R10000** CD-ROM.
12. Type: **list** and press **<ENTER>**.
13. When asked "........... more?(h=help)", press the **<SPACEBAR>**.
    The following menu appears:
    1. /CDROM/dist/
    2. done (no action)

    Install software from [CDROM/dist]
14. Eject the **IRIX 6.3 for O2 including R10000** CD-ROM and insert the **IRIX 6.3 Applications November 1996** CD-ROM.

NOTE:

During the course of the installation procedure you are prompted to swap CD-ROM’s several times. Carefully follow the instructions and pay attention to the order. Generally, when swapping the CD’s, the installation program automatically continues after a delay.

15. After waiting a few seconds press **<ENTER>** and then press the **<SPACEBAR>** *twice* when asked "........... more?(h=help)".
16. When the following menu appears:
    1. /CDROM/dist/
    2. done (no action)

    Install software from [CDROM/dist]

    Type **2** and press **<ENTER>** for done.
17. When the "more? (h=help)" message appears type: **q** (for quit) to exit the list and get the **inst >** prompt.
18. At the **inst >** prompt type **install eoe.sw.uucp** and press **<ENTER>**.
19. At the **inst >** prompt type **install eoe.sw.ppp** and press **<ENTER>**.
20. At the **inst >** prompt, type **go** and press **<ENTER>**.
21. After about 2 min. (at 16% of installation progress) the message "Type control - C to interrupt" appears**.** Eject the **IRIX 6.3 Applications November 1996** CD-ROM and insert the **IRIX 6.3 for O2 including R10000** CD-ROM. The installation continues automatically after a few seconds. This step takes approximately 7 min.
22. The installation pauses at 54% of installation progress and the following message appears *Type control - C to interrupt*.

Eject the **IRIX 6.3 for O2 including R10000** CD-ROM and insert the **IRIX 6.3 Applications November 1996** CD-ROM. The installation continues automatically after a few seconds. This step takes approximately 20 minutes.

> **NOTE:**
>
> Ignore the error messages if any appear between 96% and 97%. Ignore the message "errors occurred after ....100%   done..."

The **inst >** prompt appears at the end of procedure.

Proceed to *"UNIX IRIX 6.3 Patches Installation"*.

UNIX IRIX 6.3 Operating System Installation Without Hard Disk Format

Prior to the UNIX IRIX 6.3 Operating System Installation

Ensure that the items listed in *"Installation Procedure Prerequisites"* are present on the site before starting the installation procedure of the UNIX 6.3 Operating System, the USP, and the Mx8000 Software Version 2.51.

CAUTION

THE IRS SHOULD BE OFF DURING THE INSTALLATION OF THE UNIX 6.3 OPERATING SYSTEM, THE USP, AND THE MX8000 SOFTWARE.

THE O2 COMPUTER SHOULD BE DISCONNECTED FROM THE NETWORK DURING THE INSTALLATION OF THE UNIX 6.3 OPERATING SYSTEM, THE USP, AND THE MX8000 SOFTWARE.

Prior to the UNIX 6.3 Operating System installation perform the following:

1. Logout, and then click **Shutdown** to shutdown the O2 computer.
2. Turn the IRS power **OFF**.
3. Disconnect the O2 computer from the network.

To install the UNIX operating system proceed to the following sections:

- For 200 MHz speed processor proceed to *"UNIX IRIX 6.3 Operating System Installation on an O2 Computer with a 200 MHz Processor (after hard disk formatting)"*
- For 300 MHz speed processor proceed to *"UNIX IRIX 6.3 Operating System Installation for O2 Computer with 300 MHz Processor"*

UNIX IRIX 6.3 Operating System Installation for O2 Computer with 200 MHz processor

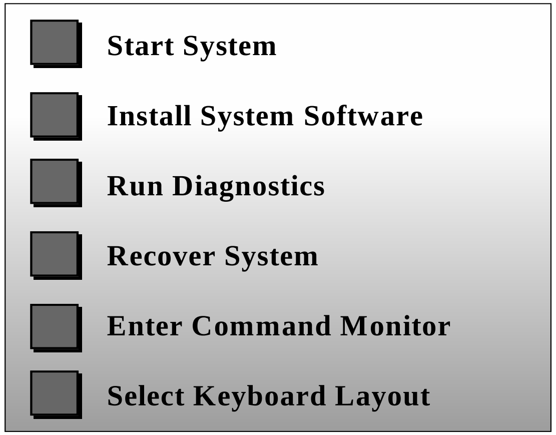
Install the UNIX IRIX 6.3 Operating System as follows:

1. Remove the memory above of 256 MB from the O2 computer.
2. Turn the system ON. When the message “The System is starting up" appears, click **Stop for Maintenance** or press **<Esc>** immediately to get the appropriate menu.

NOTE:

You have just five seconds to press **<Esc>** before the message disappears and the system starts up. If you fail to do so, wait until the system comes up (the login screen appears), turn off the system and start again.

The following menu appears:


Start System
Install System Software
Run Diagnostics
Recover System
Enter Command Monitor
Select Keyboard Layout

Proceed to *"UNIX IRIX 6.3 Operating System Installation"*.

UNIX IRIX 6.3 Operating System Installation for O2 Computer with 300 MHz Processor

Install the UNIX IRIX 6.3 Operating System as follows:

NOTE:

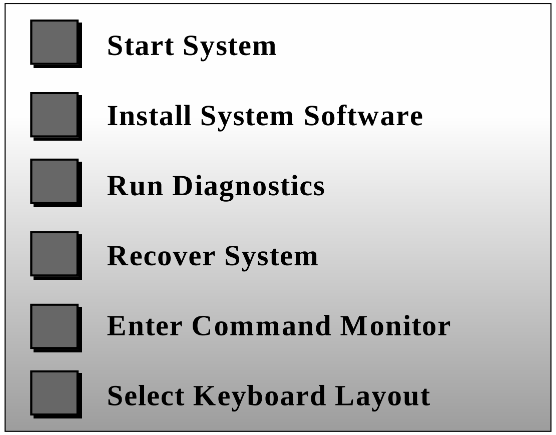
The steps in this section override the necessity for the physical removal of memory above 256 MB from the O2 computer.
In case you have removed any additional memory in excess of 256 MB omit steps 1and 2 and proceed to step 3.

1. Turn the O2 computer ON. When the message “The System is starting up" appears, click **Stop for Maintenance** or press **<Esc>** immediately to get the appropriate menu.

NOTE:

You have just five seconds to press **<Esc>** before the message disappears and the system starts up. If you fail to do so, wait until the system comes up (the login screen appears), turn off the system and start again.

The Maintenance menu appears:


Start System
Install System Software
Run Diagnostics
Recover System
Enter Command Monitor
Select Keyboard Layout

2. From the **Maintenance** menu click **Enter Command Monitor**.
3. Type: **setenv -p maxpmem 262144** and press **<ENTER>**
4. Type **Exit** to close the window and return to the **Maintenance** menu.

Proceed to *"UNIX IRIX 6.3 Operating System Installation"*.

UNIX IRIX 6.3 Operating System Installation

Continue to install the UNIX IRIX 6.3 Operating System as follows:

1. Insert the **IRIX 6.3 Recommended/Required patches (1 of 2) June 1999** CD-ROM.
2. From the **Maintenance** menu, click **Install System Software**.
3. A screen with possible installation sources opens. Click the default source (**local CD-ROM**).
   "*Local SCSI CD-ROM drive 4" is displayed.
   Click **install**.
4. The next window opens; click **continue**. The progress window of the initial installation stage **Copying installation tools to disk** opens. This process takes about 2 min. The system reboots after all the files are copied and the **Inst >** prompt appears.
5. Eject the **IRIX 6.3 Recommended/Required patches (1 of 2) June 1999** CD-ROM.
6. Insert the **IRIX 6.3 for O2 including R10000** CD-ROM.
7. At the prompt **Inst >** type **sh** and press **<ENTER>**.
8. Type **umount /root** and press **<ENTER>**.
9. At the new prompt (#), type **mkfs_xfs /dev/dsk/dks0d1s0** and press **<ENTER>**.
10. Type **mount /root** and press **<ENTER>**.
11. At the prompt (#), type **exit** and press **<ENTER>**.
12. If asked "........... more?(h=help)", press the **<SPACEBAR>**.
13. After completion of the initial stage the **Inst >** prompt appears.
14. At the **Inst >** prompt, type **list** and press **<ENTER>**.
15. If asked "........... more?(h=help)", press the **<SPACEBAR>**.
16. The following menu appears:
    1. /CDROM/dist/
    2. done (no action)

    Install software from [CDROM/dist]
17. Eject the **IRIX 6.3 for O2 including R10000** CD-ROM and insert the **IRIX 6.3 Applications November 1996** CD-ROM

NOTE:

During the course of the installation procedure you are prompted to swap CD-ROM’s several times. Carefully follow the instructions and pay attention to the order. Generally, when swapping the CD’s, the installation program automatically continues after a delay.

18. After waiting a few seconds press **<ENTER>**. Press the **<SPACEBAR>** *twice* when asked "........... more?(h=help)".
19. When the following menu appears:
    1. /CDROM/dist/
    2. done (no action)

    Install software from [CDROM/dist]

    Type **2** and press **<ENTER>** for done.
20. A list appears. Type **q** (to quit) to exit the list and get the **inst >** prompt.
21. At the **inst >** prompt, type **install eoe.sw.uucp** and press **<ENTER>**.
22. At the **inst >** prompt, type **install eoe.sw.ppp** and press **<ENTER>**.
23. At the **inst >** prompt, type **go** and press **<ENTER>**.
24. After about 2 min. (at 16% of installation progress) the following message appears: "Type control - C to interrupt."
    Eject the IRIX 6.3 Applications November 1996 CD-ROM and insert the IRIX 6.3 for O2 including R10000 CD-ROM.

    The installation continues automatically after a few seconds. This step takes approximately 7 minutes.
25. The installation pauses at 54% of installation progress and the following message appears: "Type control - C to interrupt."

    Eject the IRIX 6.3 for O2 including R10000 CD-ROM and insert the IRIX 6.3 Applications November 1996 CD-ROM.

    The installation continues automatically after a few seconds. This step takes approximately 18 minutes.

NOTE:

Ignore the error messages if any appear between 96% and 97%. Ignore the message "errors occurred after ....100% done..."

The **inst >** prompt appears at the end of procedure.

Proceed to *"UNIX IRIX 6.3 Patches Installation"*.

UNIX IRIX 6.3 Patches Installation

Install the UNIX IRIX 6.3 Patches as follows:

1. At the inst >prompt, eject the IRIX 6.3 Applications November 1996 CD-ROM and insert the **IRIX 6.3 Recommended/Required patches (1 of 2) June 1999 CD-ROM**. Wait a few seconds and at the inst > prompt.
   Type **from /CDROM/dist/6.3_O2/** and press **<ENTER>**.

   (Use an uppercase **O** when typing **6.3_O2** and not a zero.).
2. A menu appears with the message "Please enter a choice [1]". Press **<ENTER>**.
3. At the **inst >** prompt, type **go** and press **<ENTER>**. This step takes approximately 7 minutes.
4. After the installation has been completed the **inst >** prompt appears.
   Type **quit** and press **<ENTER>**. This step takes approximately 10 minutes. and when it is finished the following message is displayed: "Ready to restart the System. Restart (y/n/sh/h)?"
5. Eject the CD-ROM, type **y** and press **<ENTER>**. The system restarts.
   The Unix operating system is installed.
6. Log on using the **root** username (password: pkserv99) and perform shutdown.
7. If the memory in excess of 256 MB has been removed, perform the following:
   a. Reinstall the additional memory above 256 MB.
   b. Turn the O2 computer ON.

   If no memory has been removed, perform the following:

   a. Turn the O2 computer ON.
      When the message "Starting up the system" appears,
      click **Stop for Maintenance**, or press **<Esc>** immediately to get the **Maintenance** menu.
   b. Click **Enter Command Monitor**.

c. Type: **resetenv** and press **<ENTER>**. (This step restores the default memory size.)

d. Type: **reboot** and press **<ENTER>**. The system restarts.

THE UNIX OPERATING SYSTEM IS NOW INSTALLED.

Proceed to *"USP V1.52: Installation Instructions"*.

USP V1.52: Installation Instructions

CAUTION

ENSURE THAT IRS IS OFF DURING THE USP AND THE MX8000 SOFTWARE INSTALLATION

ENSURE THAT THE O2 COMPUTER IS DISCONNECTED FROM THE NETWORK DURING THE USP AND THE MX8000 SOFTWARE INSTALLATION.

Install the Mx8000 version 2.51 software as follows:

1. Insert the **USP V1.52** CD-ROM.
2. Login as **root** and press **<ENTER>** *twice*.
   Open a Unix Shell window (by **Menu** --> **Desktop** --> **Open Unix shell**).
3. Type **tcsh** and press **<ENTER>.**
4. Type **cd /CDROM/** and press **<ENTER>**.

NOTE:

To type the path in a command, type the first or first and second letter of each directory and then press the **<TAB>** key to complete each directory name of the path.

5. Type **pwd** and press **<ENTER>** to verify that you are in the correct path.
6. Type **./install** and press **<ENTER>** to activate the installation program. The total installation time is about 8 minutes.

NOTE:

There is a pause for about one minute after the first line **Create a swap file ......** Wait patiently and ignore the message: "failed for /swap1 no such file or directory not found…"

7. When the following message appears after 1 minute: "Create a mount point for the EOD (if not already exist)" there is a pause of 5 minutes in which the installation process takes place.
8. After the pause, the following message appears: "Enter the License key manually".
   Type **y** and press **<ENTER>**. If you have a backup of the tables, you can type **n** and press **<ENTER>**; to restore the tables refer to *"System Tables Restore Instructions"*.

NOTE:

At this stage of the installation, you must enter the license key.
Use only License Key generated for Version 2.51.

9. Enter the options license key **generated for V2.51** by typing 16 groups of 4 hexadecimal digits in each group from a printout according to your system S/N.
10. After completing all groups, enter the checksum number when prompted..

NOTE:

If you incorrectly enter the license key, complete the Mx8000 Software Installation and then see *"Entering an Option License Key (from a printout)"*.

11. At the prompt, type **cd /** and press **<ENTER>.**
12. Type **eject** and press **<ENTER>** to eject the CD-ROM.
13. Reboot is not necessary at this stage.

Proceed to *"Mx8000 Version 2.51: Installation Instructions"*.

Mx8000 Version 2.51: Installation Instructions

⚠ CAUTION

ENSURE THAT THE IRS IS OFF DURING THE MX8000 SOFTWARE INSTALLATION

ENSURE THAT THE O2 COMPUTER IS DISCONNECTED FROM THE NETWORK DURING THE MX8000 SOFTWARE INSTALLATION.

Install the Mx8000 version 2.51 software as follows:

1. Login as **root** (password: **pkserv99**).
2. Insert the **Mx8000 Version 2.51** CD-ROM.
3. To start installation, type **cd /CDROM/V2.51/Install** and press **<ENTER>**.
   (Note that the first letter of Install is in upper case.)
4. Type **pwd** and press **<ENTER>** to verify that you are in the correct path.
5. Type **./install** and press **<ENTER>**.
6. Type **y** and press **<ENTER>** to activate the installation program. The installation starts automatically and takes about 10 minutes.
7. At the prompt, type **cd /** and press **<ENTER>.**
8. Type **eject** and press **<ENTER>** to eject the CD-ROM.
9. At the end of this step the # prompt appears. Reboot the system by typing: **/etc/reboot** and pressing **<ENTER>**.
10. Shut down the O2.

If you want to restore system tables proceed to *"System Tables Restore Instructions"*.

If you do not want to restore system tables proceed to *"Hardware Dependant Tables Completion"*.

System Tables Restore Instructions

System Tables Restore

Restore the system tables as follows:

1. Turn the IRS ON and then turn the O2 ON
1. Login as **Mx8000**.
2. Ensure that the EOD cartridge with the previously performed backup is inserted in the EOD drive.
3. Select **Service|Save/Restore Tables** from the System menu. After a delay the **Backup/Restore** window opens.
4. Select the following check boxes in the **Backup/Restore** window:
   - **Restore**
   - **the device EOD**
   - **Select All for a comprehensive restore**
5. Click **Start Restore**. The restore takes a few minutes.
6. Click **Exit** when "Done" and "End Restore" are displayed in the **Report** window.
7. Eject the EOD cartridge.
8. Logout and then login as **Mx8000** the changes to take place.

Proceed to *"Verifying Network Settings"*.

Verifying Network Settings

1. Reconnect the network cable.
2. Logout from the host.
3. Login as **root** (password **pkserv99**).
4. In **Toolchest**, select **System|System Manager|Network** and **Connectivity|Set Up** and **Start Networking**.
5. Click **Next** twice.
6. Verify that the **Use Default Netmask** number is identical to the number you recorded previously in *"Network Verification (For Systems With External Devices Connected Through a Router)"*.

7. Click **Cancel**.
8. Select **Modify Networking Settings**.
9. Click **Next** twice.
10. Select **Add Default Route**.
11. Verify that the **Default Route IP Address** number is identical to the number the you recorded previously in *"Network Verification (For Systems With External Devices Connected Through a Router)"*.
12. Click **Cancel** and logout.

Default Device Storage List

1. Login as **Mx8000**.
2. Verify that the selected device storage list is according to the customer’s request by clicking **Service|Default Store Devices.** The **Generate Default Target Devices** window opens. Modify, if necessary.

Proceed to *"System Physical Calibrations and Proper Functioning Check"*.

Hardware Dependant Tables Completion

The procedures described in this chapter should be performed in case, you install the Mx8000 Software Version 2.51 without performing the Backup Restore procedure.

System Tables General Description

There are some tables used to define hardware configuration of the system. The tables listed below contain the following information:

- **T9B** - P-Plane Collimator Encoder Settings;
- **T0A** - Water Cooling System (WCS) type definition
- **T2A** - Tilt Motor type definition

Table T9B has different format than T0A and T2A Tables. These differences are described in appropriate procedures in this section.

If the Water-Water Cooling System is installed on the site you can omit the procedure described in *"Cooling System Type Definition (T0A Table)"*.

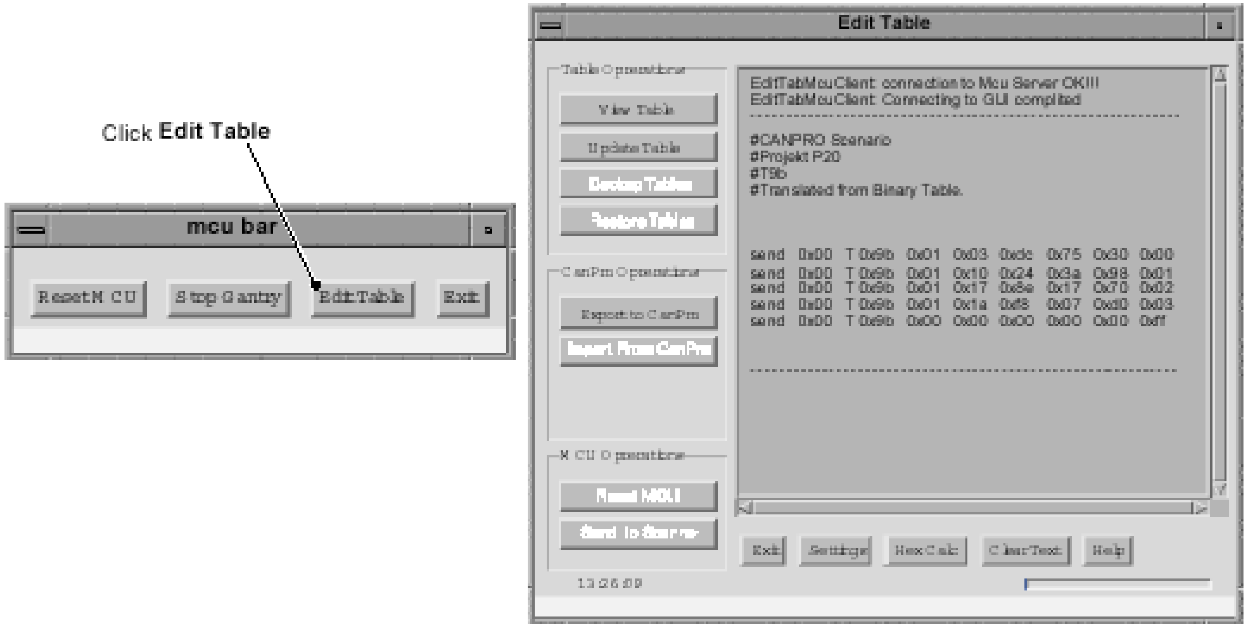
If the Tilt Motor of a new type installed on the site you can omit the procedure described in *"Tilt Motor Type Definition (T2A Table)"*.

Proceed to *"P-Plane Collimator Encoder Settings"*.

P-Plane Collimator Encoder Settings

The P-Plane collimator encoder settings for each system cradle are specified in the P-Plane Collimator document shipped with the system (D/N 451-7180-0506 in the envelope with the DMS, Data Measuring System). This procedure describes how to enter the new encoder settings on the host computer.

1. With the application software running on the host computer, click on **Service | MCU Utilities** to display the MCU bar window.
2. Click **Edit Table** to display the Edit Table window (see *Figure 14-2*).


Click Edit Table
mcu bar
Reset MCU
Stop Gantry
Edit Table
Exit
Edit Table
Table Operations
View Table
Update Table
Backup Tables
Restore Tables
CanPro Operations
Export to CanPro
Import From CanPro
MCU Operations
Reset MCU
Send to Scanner
Exit
Settings
HexCalc
Clear Text
Help
13:26:09

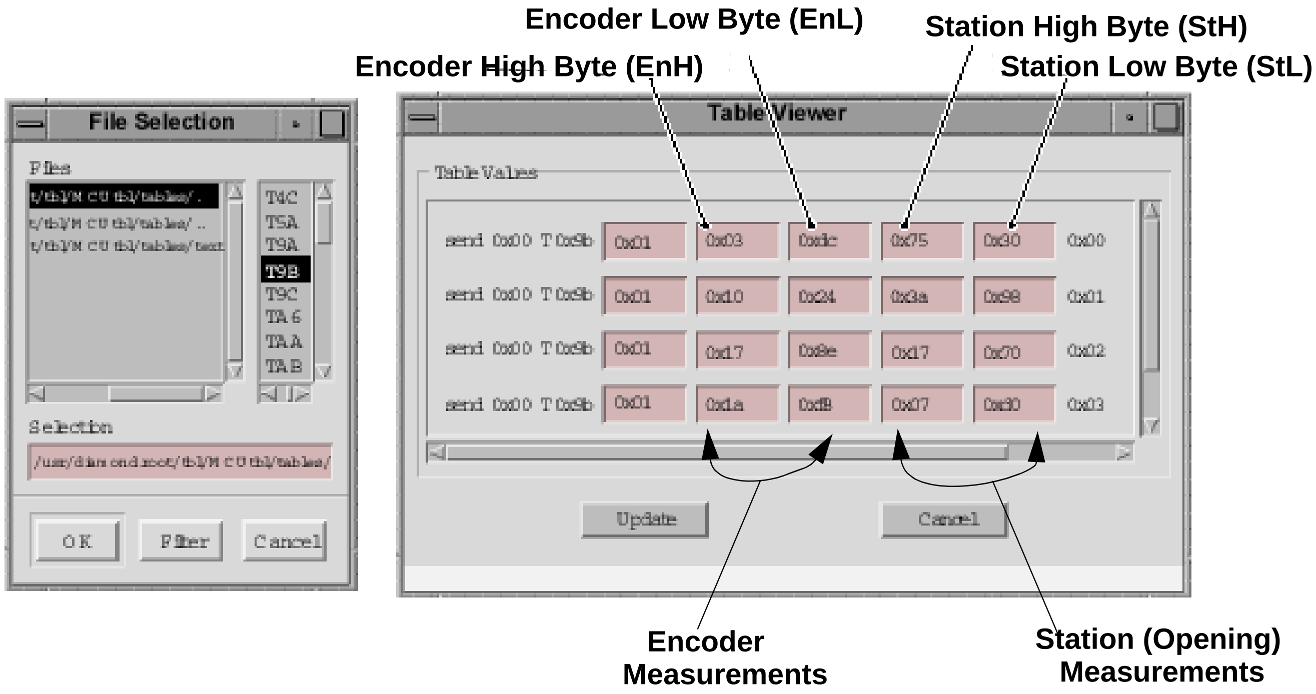
```
EditTabMcuClient: connection to Mcu Server OK!!!
EditTabMcuClient: Connecting to GUI complited
-------------------------------------------------------------

#CANPRO Scenario
#Projekt P20
#T9b
#Translated from Binary Table.


send  0x00  T 0x9b  0x01  0x03  0xdc  0x75  0x30  0x00
send  0x00  T 0x9b  0x01  0x10  0x24  0x3a  0x98  0x01
send  0x00  T 0x9b  0x01  0x17  0x8e  0x17  0x70  0x02
send  0x00  T 0x9b  0x01  0x1a  0xf8  0x07  0xd0  0x03
send  0x00  T 0x9b  0x00  0x00  0x00  0x00  0x00  0xff


-------------------------------------------------------------
```

Figure 14-2: MCU bar and Edit Table Windows

NOTE:

Only the first two lines in the Edit Table window are displayed when the Edit Table window is first displayed. Table values are shown only after viewing a selected table.

3. Click **Update Table** to display the File Selection window (see *Figure 14-3*).
4. Scroll down to find and select table T9B. Click **OK** (see *Figure 14-3*).


Encoder Low Byte (EnL)
Station High Byte (StH)
Encoder High Byte (EnH)
Station Low Byte (StL)
File Selection
Files
T4C
T5A
T9A
T9B
T9C
TA6
TAA
TAB
Selection
OK
Filter
Cancel
Table Viewer
Table Vales
Update
Cancel
Encoder Measurements
Station (Opening) Measurements

send 0x00 T 0x9b	0x01	0x03	0xdc	0x75	0x30	0x00
send 0x00 T 0x9b	0x01	0x10	0x24	0x3a	0x98	0x01
send 0x00 T 0x9b	0x01	0x17	0x8e	0x17	0x70	0x02
send 0x00 T 0x9b	0x01	0x1a	0xf8	0x07	0x30	0x03

Figure 14-3: File Selection Window and Table Viewer

5. Modify the values in the Table Viewer window. Replace the **EnH**, **EnL**, **StH** and **StL** values in each line with the appropriate values from the P-Plane Collimator document.

   In the P-Plane Collimator document there are two tables: one table of encoder measurements and on of station measurements. In these tables there is a column that says "(Hexa)". The numbers in this column are the numbers that you enter in the Window.

   The number in the first row in the document goes in row **0x00** in the window; the number in the second row in the document goes in row **0x01** in the window; etc.

   Divide each four-digit number into two two-digit numbers. (If the number is only three digits, add a leading zero). Enter the first two digits in the high byte field, and the last two digits in the low byte field.

For example: If the first number in the "Encoder Measurements (Hexa)" column is 415, you enter 0x04 in **EnH** and 0x15 in **EnL**.

6. Click **Update** after entering the data for the system to accept the data.
7. On the **Edit Table** window, click **View Table**, select **T9B** and click **OK** to check that the host is updated.
8. Switch off the Gantry.
9. Select **Logout** from the **File** menu on the **Patient Data Screen**. Switch ON the Gantry and login.

If the Water-Water Cooling System is installed on the site you can omit the *"Cooling System Type Definition (T0A Table)"*,

Otherwise, proceed to *"WCS and Tilt Motor Type Definition"*.

WCS and Tilt Motor Type Definition

Use the following procedure to edit the T0A and T2A Tables:

1. Login as **Mx8000**.
2. Verify the tables by **Service | MCU Utilities | Edit Table | View Tables.**
3. Make sure to select the table (**T0A** or **T2A**), that you are going to change and click **OK.**
4. Change the underlined and bold fields as shown in the appropriate subchapters below (see *"Cooling System Type Definition (T0A Table)"* or *"Tilt Motor Type Definition (T2A Table)"*).
5. Click **Update** and **Exit**.
6. **Logout** and than **Login** for the changes to take effect.

Cooling System Type Definition (T0A Table)

T0A Table is used for the Water Cooling System (WCS) type definition: for Water-Water or Water-Air WCS.

The following underlined and bold parameters should be changed according to the WCS type installed in the system.

T0A WCS Parameters for Water-Water Exchanger (default)

```
send 0x00 T 0x0A 0x01 0x18 0x00 0xAA 0x01 0x00
send 0x00 T 0x0A 0x00 0xB9 0x17 0x70 0x0F 0x01
send 0x00 T 0x0A 0x05 0x14 0x00 0x64 0x00 0x02
send 0x00 T 0x0A 0x00 0x00 0x00 0x00 0x00 0xFF
```

T0A WCS Parameters for Water-Air Exchanger

```
send 0x00 T 0x0A 0x01 0x18 0x00 0xAA 0x02 0x00
send 0x00 T 0x0A 0x00 0xB9 0x17 0x70 0x0F 0x01
send 0x00 T 0x0A 0x01 0xF4 0x01 0x2C 0x00 0x02
send 0x00 T 0x0A 0x00 0x00 0x00 0x00 0x00 0xFF
```

If the Tilt Motor of new type installed on the site, you can skip *"Tilt Motor Type Definition (T2A Table)"* Otherwise, proceed to *"Tilt Motor Type Definition (T2A Table)"*. To determine which Tilt Motor is installed in the system, see *Figure 14-4* and *Figure 14-5*.

Tilt Motor Type Definition (T2A Table)

T2A Table is used for the Tilt Motor type definition: New Tilt motor P/N SP7148 07 777 or Old Tilt motor P/N SP7127 93 219.

T2A for New Tilt Motor P/N SP714807777 (default)

```
send 0x00 T 0x2A 0x03 0x60 0x14 0x00 0x01 0x00
send 0x00 T 0x2A 0x64 0x09 0x88 0x07 0xF8 0x01
send 0x00 T 0x2A 0x8C 0x8C 0x28 0x64 0x64 0x02
send 0x00 T 0x2A 0x08 0x08 0x52 0xDC 0x14 0x03
send 0x00 T 0x2A 0x3C 0x03 0x0F 0x14 0x00 0x04
send 0x00 T 0x2A 0x00 0x64 0x00 0x00 0x00 0x05
send 0x00 T 0x2A 0x07 0x07 0x02 0x4B 0x17 0xFF
```

T2A for Old Tilt Motor P/N SP712793219

```
send 0x00 T 0x2A 0x03 0x60 0x14 0x00 0x01 0x00
send 0x00 T 0x2A 0x64 0x09 0x88 0x07 0xF8 0x01
send 0x00 T 0x2A 0x8C 0x8C 0x28 0x64 0x64 0x02
send 0x00 T 0x2A 0x08 0x08 0x52 0xC8 0x14 0x03
send 0x00 T 0x2A 0x28 0x03 0x13 0x00 0x00 0x04
send 0x00 T 0x2A 0x00 0x64 0x00 0x00 0x00 0x05
send 0x00 T 0x2A 0x07 0x07 0x02 0x4B 0x17 0xFF
```

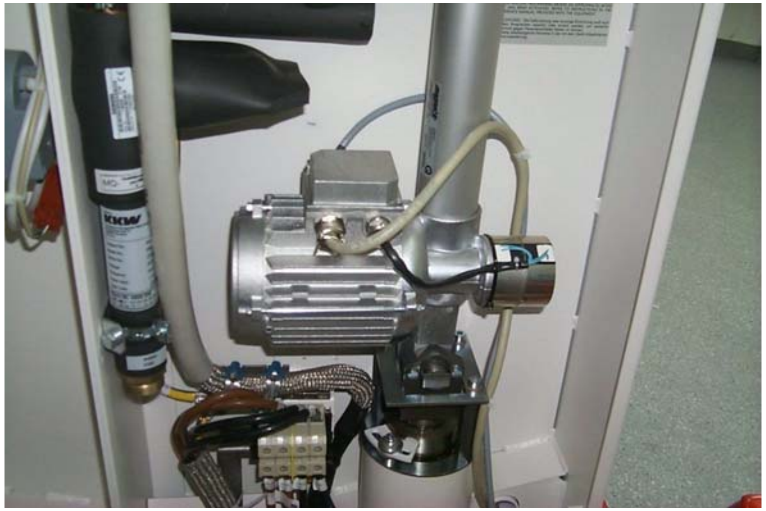


Figure 14-4: New Tilt Spindle

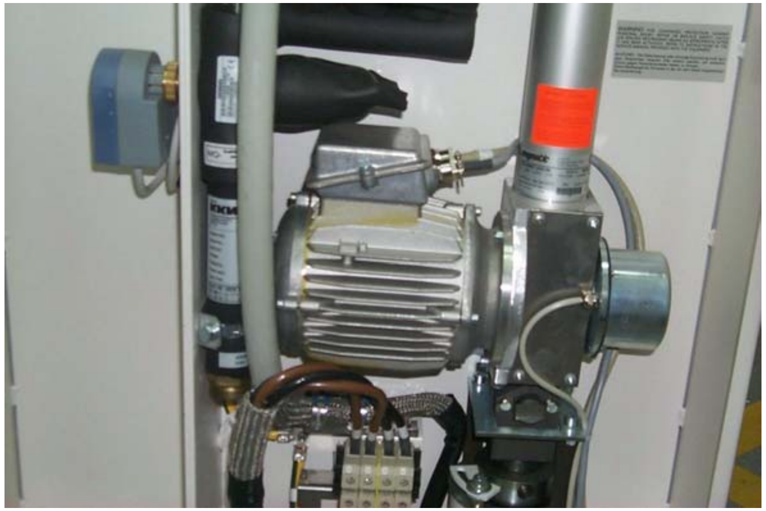


Figure 14-5: Old Tilt Spindle

System Physical Calibrations and Proper Functioning Check

System Physical Calibrations

Perform the procedure described below if, after Mx8000 software installation, the System Tables Backup Restore is not performed/not available.

All Physical and Air calibrations listed below, should be performed for all modes according to the Mx8000 Physics File for Version 2.5.

See Section *"Service and Calibration Tools"* for additional instructions on performing the following system calibrations:

- A-Collimator Z-Direction Calibration
- DFS and Axis Calibration (Current Calibration)
- Impulse Response Measurement
- Slice Width Measurement
- Phantom calibrations
- Air Calibration
- Image Noise (SD) Check
- HCOR calibration
- Image Quality Check
- Filament Calibration
- Current Calibration

Proceed to *"HIS/RIS Settings Verification (Only for Sites using HIS/RIS)"*.

If the System Tables Backup Restore is performed, the following calibrations have to be done.

- Filament Calibration
- Current Calibration

Proceed to *"HIS/RIS Settings Verification (Only for Sites using HIS/RIS)"*.

HIS/RIS Settings Verification (Only for Sites using HIS/RIS)

1. Check that the Modality Work List (HIS/RIS) on the site is used as follows:
    a. Check **New Patient** to open the **Patient Data** window.
    b. If the icon **HIS/RIS** exists, **HIS/RIS** is used on this site.
2. Perform the following procedure if Modality Work List (HIS/RIS) is used:
    a. Select **Service|Service Parameters**. The **Configuration** dialog box appears.
    b. Select the **HIS/RIS** tab.
    c. If **Station Name** in the check box is unchecked—click **Cancel**.
    If **Station Name** in the check box is checked — deselect it, click **OK,** and perform logout.
    Login as **Mx8000** for changes to take effect.
    d. Check that HIS/RIS functions properly.

NOTE:

In a multi-scanner environment, it is possible to perform MWL query per scanner as follows:

a. Define the AE title in the HIS/RIS.
b. Enable the "station name" in the scanner in the HIS/RIS service parameters settings.

Proceed to *"Service (IRS) Diagnostic Key Installation"*.

Service (IRS) Diagnostic Key Installation

The Service (IRS) Diagnostic Key installation is not a mandatory step of the software installation procedure.
Skip the Service (IRS) Diagnostic Key installation if you do not have a Service (IRS) Diagnostic Key printout on the site.
It can be installed later at any time.

For the Service (IRS) Diagnostic Key installation see *"Entering Service (IRS) Diagnostic Key"*.

Proceed to *"System Proper Functioning Check"*.

System Proper Functioning Check

Check image quality and the system proper functioning by performing some scans on Head and Body Layers of the System Phantom at different modes.

Proceed to *"Mx8000 System Network Configuration"*.

Mx8000 System Network Configuration

To perform the network configuration see *Chapter 8 "Network Configuration"*.

Proceed to *"Final Steps"*.

Final Steps

System Performance and Image Quality Check

Check the system with the Mx8000 Version 2.51 software and firmware. Perform some scans in various modes with different scan parameters to ensure proper system functioning and image quality. Check the proper connection and functioning of all network devices.

Proceed to *"Version 2.51 System Tables Backup"*.

Version 2.51 System Tables Backup

Perform a backup of all system tables to an EOD.

License Keys

Entering an Option License Key (from a printout)

Enter an option license key separately after the Software Installation, as follows:

1. Login as **root**. Open a Unix shell.
2. Type: **cd /usr/usp.root/tamar/bin/** and press **<ENTER>**.
3. To verify the path, type: **pwd** and press **<ENTER>**.
4. Type: **./setpwd** and press **<ENTER>**.
5. Enter the license key by typing 16 groups of 4 hexadecimal digits in each group from a printout according to your system S/N.
6. After completing all groups it asks for the checksum number.
7. At the prompt, reboot the system by typing: **/etc/reboot** and pressing **<ENTER>**.

Verifying the System Options

Type: **/usr/diamond.root/bin/test_key** and press **<ENTER>**. The installed options are displayed on the screen.

Entering Service (IRS) Diagnostic Key

1. Log in as **root**
2. Type: **cd /usr/diamond.root/diagnostic** and press **<ENTER>**.
3. Type: **./installKey** and press **<ENTER>**.
4. Enter the 32 hexadecimal digit and the 4 check sum number from a printout according to your system S/N.
   - — No user interface changes.
   - — Full calibration takes about 25 minutes more.

xfscopy

The xfscopy command is a utility for duplicating hard-disk contents.

1. Shut down the O2 computer.
2. Insert the second hard-drive (to be duplicated) into the O2 drive bay.
3. Turn the O2 computer ON.
4. Login as **root** (password **pkserv99**).
5. Type: **cd /usr/diamond.root/Install** and press **<ENTER>**.
6. Type: **./xfscopy** and press **<ENTER>**.
7. Type: **y** and press **<ENTER>** twice.
   The system reboots automatically.
8. When the message appears: *type ctrl-d to process with normal startup*
   (or give root password for single user mode),
   type: **pkserv99** and press **<ENTER>** twice.
9. Type: **cd /usr/diamond.root/Install** and press **<ENTER>**.
10. Type: **./xfscopy** and press **<ENTER>**.
11. When the message ”**Are you sure you wish to continue (y/n) [n]**” appears, type **Y** and press **<ENTER>.**
    The system starts to copy files from the system disk to the second disk. This procedure takes 20 minutes.
12. When the message scripts is finished appears, type: **d** to shut down the O2 computer.

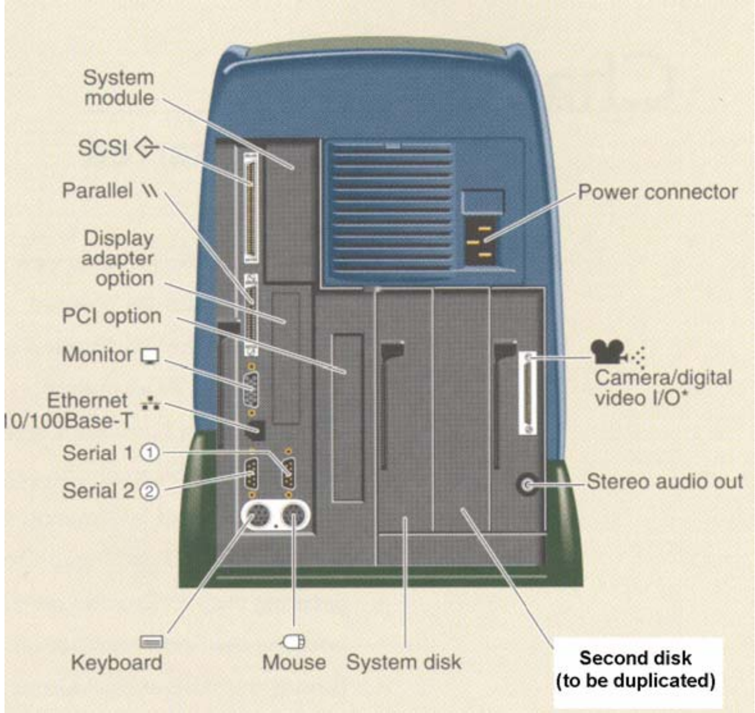

System module
SCSI
Parallel
Display adapter option
PCI option
Monitor
Ethernet 10/100Base-T
Serial 1 ①
Serial 2 ②
Keyboard
Mouse
System disk
Second disk (to be duplicated)
Power connector
Camera/digital video I/O*
Stereo audio out

Figure 14-6: The O2 Computer with Added Hard-disk

NOTE: The new hard-disk containing the copied data should be used ONLY in this O2 computer. There is no guarantee that it functions properly in any other computer (even of the same type).

Chapter 15
Image Quality

Preface 15-1

Procedure for Image Quality Problem Analysis 15-2

- Tool/Procedures for Analyzing Image Quality Problems 15-4
- GI (Gated Integrator Card) 15-5
- Rings 15-6
- Procedure for Ring Analysis 15-8
- Bias Checking 15-12
- Bands 15-13
- Streaks 15-13
- Replacing Single Detector Modules 15-14
- UH Collimator Adjustment 15-16
- High Resolution DFS Calibration 15-18
- Ultra High-Resolution Calibration 15-20
- Mechanical Adjustment Procedure 15-23
- Prepare for Retesting 15-24
- Completion Procedure 15-24
- Ultra High Resolution Pre-alignment with X-ray Film 15-25

Other Artifacts 15-30

- Arcing Problems 15-30
- Reconstruction Problems 15-30
- Software Problems 15-31

FEE Bias Test 15-32

General 15-32

FEE Bias, Noise, Leakage, and, Signal Test Instructions 15-33

- Scans Without X-ray 15-33
- Scans in Air With X-ray 15-37

Reference Detector Assembly Check 15-40

General 15-40

Procedure 15-41

- Scans Without X-ray 15-41
- Scan With X-ray 15-44

Replacing a Six Module Set 15-45

General 15-45

Procedure 15-46

Miscellaneous 15-51

Bad Detector Table 15-51

GI Card Replacement 15-51

A Band on Body Image 15-52

Phantom Calibration 15-52

Single Module Replacement 15-52

Cleaning Detector QS Modules with ACL Staticide Wipes SW-12 15-53

Introduction 15-53
General 15-53
Safety Measures When Using ACL 15-54
First Aid Measures 15-54
Cleaning Procedure 15-55
    Preparations 15-55
    Cleaning 15-56
Examples of Real Problems 15-60

GI/Module Table 15-61

Preface

The purpose of this chapter is to provide the service engineer with information needed to troubleshoot and solve image quality problems.

The information included here is intended for Mx8000 Quad and Dual systems. Parts or special tools needed for any procedure are specified for each case.

This chapter is structured such that each proMx8000 and Mx8000 Dualcedure can be performed separately. There is a short description of the image quality problem solved before each procedure.

Procedure for Image Quality Problem Analysis

The most common image quality problems are rings, bands and streak artifacts. These artifacts are usually caused by a fault in the DMS, but others problems such as arcing, reconstruction, or software problems occur. For software problems see *“Software Problems”*.

The following information regarding system performance is necessary to analyze image quality problems:

- Does the problem occur in Head or Body scans or both.
- Does the problem occur in all three voltages or only in a specific one.
- Does it occur in all slice widths or only in a specific slice width.
- Is the problem dependent on the rotation time.
- Is the problem dependent on the mAs.
- Does the problem occur in standard, high, or ultra-high resolution.
- Is the problem intermittent or continuous.
- Does the problem occur in the upper part of the skull (partial volume problem).
- Does the problem occur at a specific reconstruction filter.

Image quality problems are generally addressed to the Field Engineer by the customer. Artifacts such as rings or streaks on clinical images lack information; there are usually only images or hard-copy film for viewing.

Image quality analysis requires **Axial** scans only. It is necessary to **repeat** the scan with the **same** scan parameters as the bad image. If the artifact appears on Helix scans, perform Axial scans with scan parameters as identical as possible to the Helix scan parameters system phantom water layer.

The parameters are:

- kV
- mAs
- Slice Width
- Rotation Time
- Resolution
- Recon Time

If an image quality problem is observed during routine P.M., do the analysis on an Axial scan only.

Use the information from the performed scans according to *Table 15-1* to determine in what mode the problem occurs. This can aid you in reaching the conclusion as to the source of the problem.

Table 15-1:

	HEAD/BODY
kV	90, 120, 140
Slice Width	2x0.5, 4x1, 4x2.5, 4x5, 2x8, 2x10
Rotation Time (sec)	0.5, 0.75, 1.0, 1.5, 2
Resolution	STD, High, UH

NOTE:

Store Raw Data for further use by **Misc**-->**Service Parameter**s-->**Store Raw**.

For Raw transfer in file form from the O2 workstation to a remote station refer to Technical Note CT2891-023A, "*FTP Connection to Mx8000*".

Tool/Procedures for Analyzing Image Quality Problems

Use Raw data acquired according to the following procedure:

NOTE:

The items procedures below can performed sequentially or can be performed individually.

- Ring Identification (*“Procedure for Ring Analysis”*)
- Reconstruction: Raw to filter or Prep to filter (*“Procedure for Ring Analysis”*)
- Analysis (at Service Function) (*Step 4*)
- FEE Bias Test (*“FEE Bias, Noise, Leakage, and, Signal Test Instructions”*)

The Ring Identification and Raw to Filter Reconstruction are used to identify faulty channels. The Analysis and FEE Bias Test are used for determining the nature of the problem and can lead to the decision on action to be taken.

Use the results received from the scans done according to *Table 15-1* and the procedures to find the possible reason for the bad image.

Table 15-1 lists possible reasons for each element involved in the scans

GI (Gated Integrator Card)

There are 42 Gated Integrator (GI) cards in the GI crate. The GI card processes the input current of 32 detectors (128 segments). After multiplexing integration and sampling, detector segment output signals are converted into 16 x 4 channels (four slices). All channels are converted to digital format data.

Table 15-2:

	POSSIBLE REASONS	
Head Only	Bad Calibrations, Software, GI card, or Detectors	
Body Only	Bad Calibrations, Software, GI card, or Detectors	
Both Head and Body	See other parameters below	
Slice Width	For all slice widths—Module For a specific SW use the Tools/Procedures for further analysis.	
Rotation Time	All scan speeds—see other parameters Scan time 0.5 sec.—check Axes calibration Scan Time1, 1.5, 2 sec.—check DFS and Axes calibration	
Resolution	**STD and UH**	GI card or Detector and Axes calibration
	UH Only	Check DFS calibration Check UH collimator alignment (see *“UH Collimator Adjustment”*)

Rings

In third-generation scanners, Axial/Helix images are composed of fine rings. These rings are not normally apparent due to the quality of the DMS and calibrations. The Mx8000 has 672 detectors in 42 modules connected to 42 GI cards (see *Figure 15-1*).

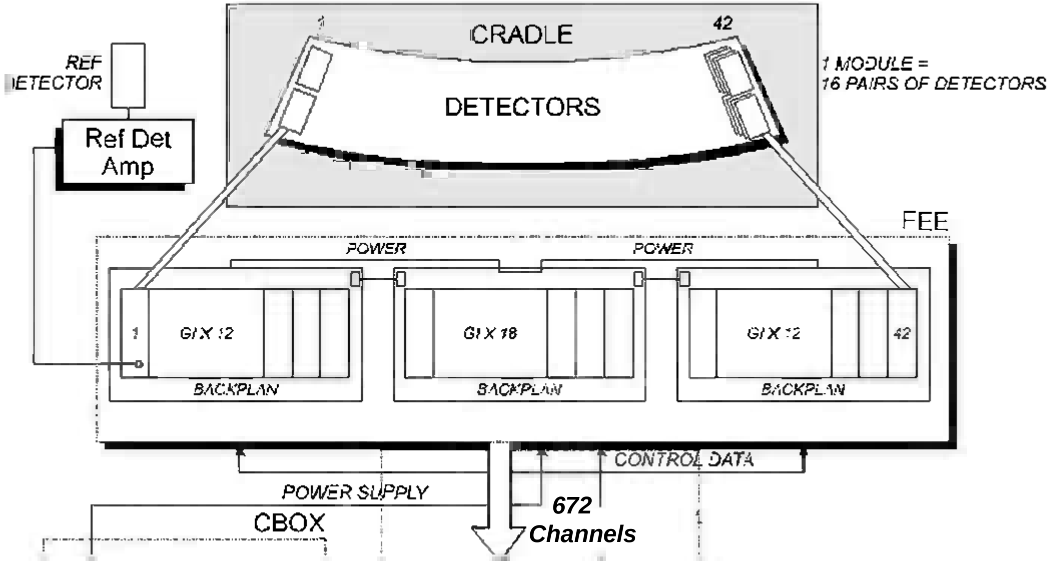

REF
DETECTOR
Ref Det
Amp
1
CRADLE
42
DETECTORS
1 MODULE =
16 PAIRS OF DETECTORS
FEE
POWER
POWER
1
GI X 12
GI X 18
GI X 12
42
BACKPLAN
BACKPLAN
BACKPLAN
CONTROL DATA
POWER SUPPLY
CBOX
672
Channels

Figure 15-1: DMS Data Channels

A data channel is composed of a specific detector and its GI card. A ring appears on an image because the channel differs from those adjacent to it. The faulty part may be a module or GI card. Use the *"Procedure for Ring Analysis"*.

Check all slices when rings appear in a specific modes. It is possible that the ring appears in a single slice only. For example, a ring is visible only on slice B and not on A, C, and D.

Figure 15-2 shows ring and band artifacts in the center (reconstructed without I.B. and without M.P. calibration (Phantom Calibration).

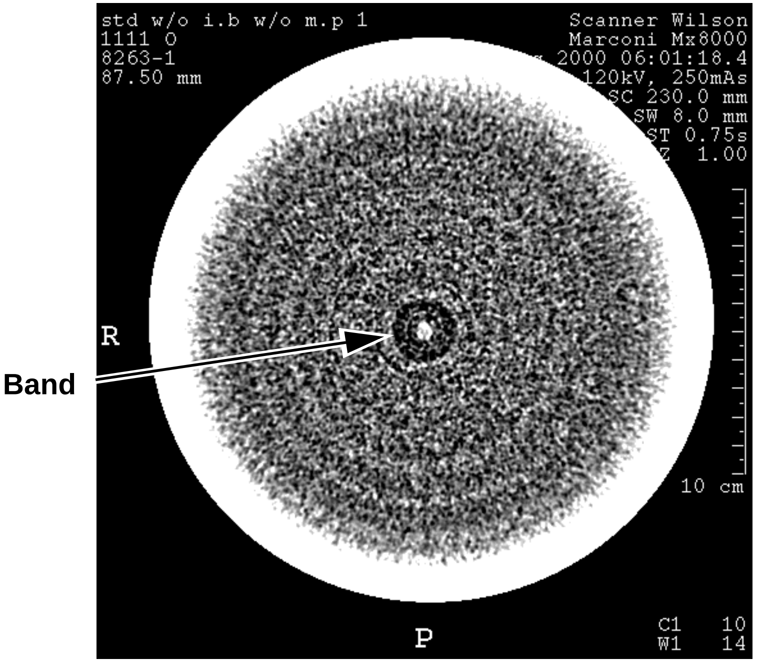

std w/o i.b w/o m.p 1
1111 0
8263-1
87.50 mm
Scanner Wilson
Marconi Mx8000
2000 06:01:18.4
120kV, 250mAs
SC 230.0 mm
SW 8.0 mm
ST 0.75s
Z 1.00
R
Band
10 cm
P
C1 10
W1 14

Figure 15-2: Image with Ring Artifacts

NOTE:

For diagnostic purposes set:

Phantom Calibration = NO
Image Balance = NO

Return both to **Yes** at the completion of all tests.

Procedure for Ring Analysis

1. Isolate the slice having the ring problem.
2. Use the **Ring Identification Program** for that slice (at **Service** --> **Ring Identification)**. Obtain the image from the archive.
3. Click **Ring.** A circle appears. You can reduce or enlarge it until it precisely matches the ring.
   Two possible channels for each ring are available. For example:

	RIGHT	**LEFT**
Ref. Det	200	475
GI Module	13 (8)	30 (11)

200 - channel number

13 - GI card/Module in DMS

8 - The channel inside the GI card/Module

> **NOTE:**
>
> The program has an accuracy of ±1 Det. Use it as a first step for channel identification.
>
> See the step-by step reconstruction below for more precise identification.

4. Reconstruction of the Stored Raw until filter stage (or Reconstruction of Prep to filter stage):
   a. From the **Service** menu, select **Analysis.** In the Analysis window, click **Archive**, and then, in the Archives Manager window, click on the **IRS** icon. Select Raw/Prep Data and then click **OK.**
   b. In the Analysis window, select **Prep/Std. Filter**.
   c. In the Recon Parameters window (Prep SubStages), clear **Phantom calibration** and **Slice normalization.** Click **OK**. After reconstruction, the Display Raw/Prep window appears.

d. Select the desired slice (A,B,C, or D) and click **Along Detector**.

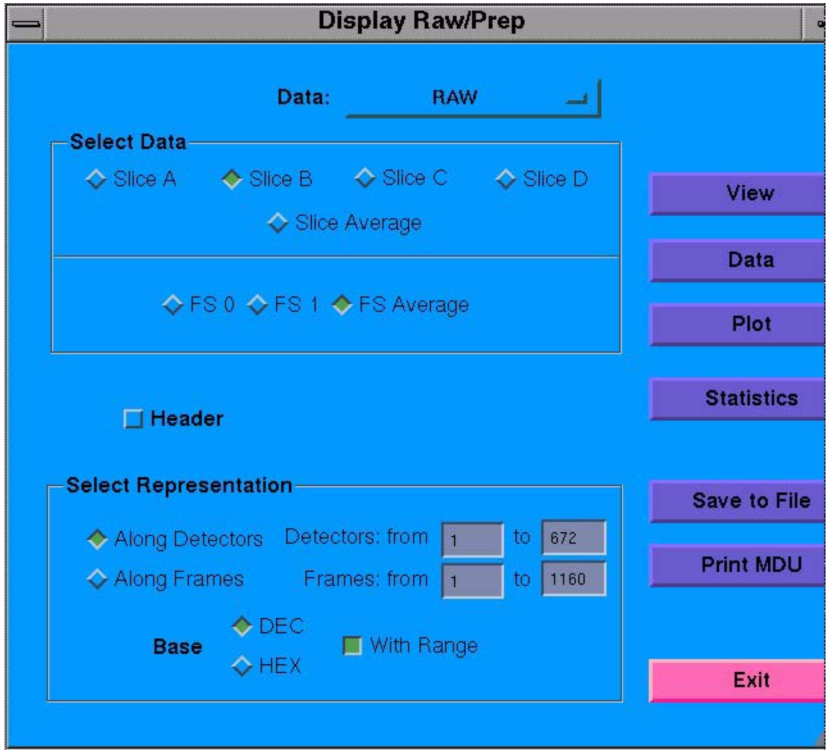
To view the filter data:

- Click **Data** for numerical values
- Click **Plot** for a graph
- Click **Statistics**

On the filter image you are able to identify the ring. It appears as a vertical line.
A faulty channel is visible in the filtered image. It differs from its neighboring channels by being darker or whiter or as a broken line. The vertical line may be identified by using the mouse. While moving the cursor with the left mouse button, the channel number is displayed on the screen.

5. Use the **Analysis** function to view the channels as numerical values or as an image or plot function.
    a. In the Analysis window, click **Archive**, and then, in the Archives Manager window, click on the **IRS** icon. Select a specific Raw/Data and then click **OK**.
    b. In the Analysis window, click **Raw/Bias**. The Display Raw/Prep window opens (see *Figure 15-3*).
    c. In the Data list, select **RAW**.
    d. Click **View** for image, or **Data**, or **Plot**, or **Statistics**.

If the analysis shows a channel having wrong Raw values, the module is faulty.


Display Raw/Prep
Select Data
◇ Slice A
◆ Slice B
◇ Slice C
◇ Slice D
◇ Slice Average
◇ FS 0
◇ FS 1
◆ FS Average
☐ Header
Select Representation
◆ Along Detectors
◇ Along Frames
Base
◆ DEC
◇ HEX
☑ With Range
View
Data
Plot
Statistics
Save to File
Print MDU
Exit

Data: RAW

Detectors: from 1 to 672

Frames: from 1 to 1160

Figure 15-3: Display Raw/Prep Window

Wrong Raw data (on a specific channel) may be caused from one of the following:

- Raw = Bias
  There is no "output" from the detector so that the data is just noise. The problem is normally a faulty detector.
- Raw data of scans performed on the system phantom water layer of a specific channel differs significantly as in the following example:

CHANNEL #	**RAW VALUE**
300	6000L
301	4000L
302	6010L

  Channel 301 is the faulty channel.
  The problem may be a detector or a GI card. The final conclusion is made after swapping GI cards. If the problem exists in the same channel, the problem is a faulty module. If the problem "moves" with the GI card, the problem is the GI card.
  For GI card replacement, (see *"GI Card Replacement"*).
  For module replacement, (see *"Replacing Single Detector Modules"*).

- An inconsistency in the Raw data values along the view (on Filter data image it is seen as a broken vertical line or as a single dot. When using statistics, the SD of the channel is very high in comparison to those adjacent to it. This indicates that there is light penetration to the detectors (see *"FEE Bias Test"*).

Follow the instructions in *"Replacing Single Detector Modules"* or see *"Replacing a Six Module Set"* if a center module is faulty (this requires replacement of the six center modules).

Bias Checking

1. In the Analysis window, click **Archive**, and then, in the Archives Manager window, click on the **IRS** icon. Select a specific Raw/Data and then click **OK**.
2. View the measured biases as follows:
   a. In the Display Raw/Prep window, select **Measured Bias** from the Data list and then select the desired slice (A,B,C, or D).
   b. Click **Data.**

A faulty channel can have bias values as zero or values outside the tolerance (see *"FEE Bias, Noise, Leakage, and, Signal Test Instructions"*).

For instructions and tolerances see *"GI Card Replacement"*.

NOTE:

View the leakage current as follows:

In the Display Raw/Prep window, select **Calculated Bias** from the Data list and then select the desired slice (A,B,C, or D). **Calculated Bias --> Data**.

Click **Calculate**.

Bands

The instructions listed above are tools for finding a faulty channel. Use the same tools for analyzing a band problem.

A band can be seen on one or more slices, especially at lower rotation speeds, e.g. 1, 1.5, or 2 sec.

It can be seen on the filter as several vertical lines that can be 4, 8, or 16 channels. At first replace that GI card (see *“GI Card Replacement”*).

NOTE:

A similar problem seen in 2, 4, 8, or 16 channels indicates a “digital” problem, i.e. probably a GI card.

Streaks

Streaks can be seen on the prep data or filter as a dot or broken line if there is light leakage from the anti-scatter grid.

Perform a scan on the system phantom on pins layer for streak artifacts. If streaks appear from or near the Teflon pins, check the DFS calibration.

See *“FEE Bias, Noise, Leakage, and, Signal Test Instructions”* for instructions and procedures.

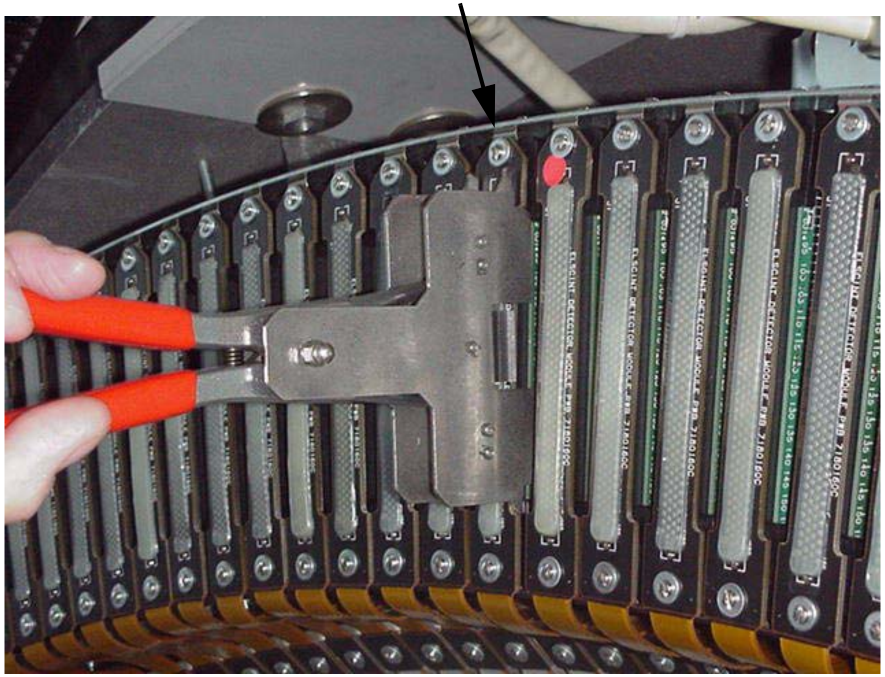
Replacing Single Detector Modules

CAUTION

FOLLOW ALL ESD PROTECTION GUIDELINES OUTLINED IN SECTION *“ESD (Electrostatic Discharge)”*.

Replace a detector module as follows:

1. Move the bed to the maximum out and maximum down position.
2. Open the front Gantry cover carefully while observing the mylar gasket. Remove the gasket and place it aside.
3. Turn Service Switch S-301OFF(to **0** position).
4. Switch OFF Circuit Breaker F9 (DMS power).
5. Manually rotate the gantry rotor in the clockwise direction and bring the DMS to a 12 o’clock position (see *Figure 15-7*).
   Lock the rotor with the locking pin.
6. Remove the cover of the DMS.
7. On the GI card for the detector module you are replacing, open the two screws that secure the connector in place.
8. Open the screw that secures the flexible/rigid cable to the detector module.
9. Use the connector extract tool (P/N ZT71800330A) to remove the connector from the GI card (see *Figure 15-4*).



Notice the GI card fastener. Lift the fastener to remove a GI card.

Figure 15-4: Using the Connector Extract Tool to Remove the Connector

10. Remove the defective detector module as follows:
    a. Open the screw that holds the module in place using a 5 mm Allen key.
    b. Gently pull the module towards you until it is out of the cradle and place the module in a safe place.

> **NOTE:**
>
> Do ***not*** use force to remove the module.

11. Unpack the new detector module and gently slide it into its place. Make sure that the pins on the cradle fit into the space provided for them on the detector module.
12. Lock the module in place by tightening the screw with a torque of 20 Nm.
13. Close the screw that connects the flexible/rigid cable to the module with a torque of 40 Ncm.
14. Reconnect the GI connector and tighten the two screws with a torque of 40 Ncm.
15. Close the cover of the DMS and tighten the screw with a torque of 20 Nm using a 5 mm Allen key.
16. Reconnect the cover connectors as follows:
    a. Reconnect the temperature sensor connector (P6 to the RCOM card).
    b. Reconnect the temperature sensor connector on the left side of the cover.
    c. Reconnect the power connector for the fans (P10 on the right side of the cover).
17. Release the rotor locking pin.

UH Collimator Adjustment

This procedure is required if there is a problem in image quality that appears only in this mode as seen in *Figure 15-5*.

The adjustment procedure includes an automatic axes measurement, performed with the UHR DFS calibration application. In most cases this procedure is sufficient.

However, there are cases where the collimator was misaligned by mistake in the field in a manner that the program is not capable of calculating the axes correctly. In this case pre-alignment with X-ray film is required.

The Ultra-High collimator mechanical adjustment is accurate if the axes for high resolution are accurate and if the image quality for high-resolution mode is good (no rings artifacts in the center, and no bad detectors are listed in the bad detector list). Therefore, the adjustment procedure must start with the DFS high-resolution mode.

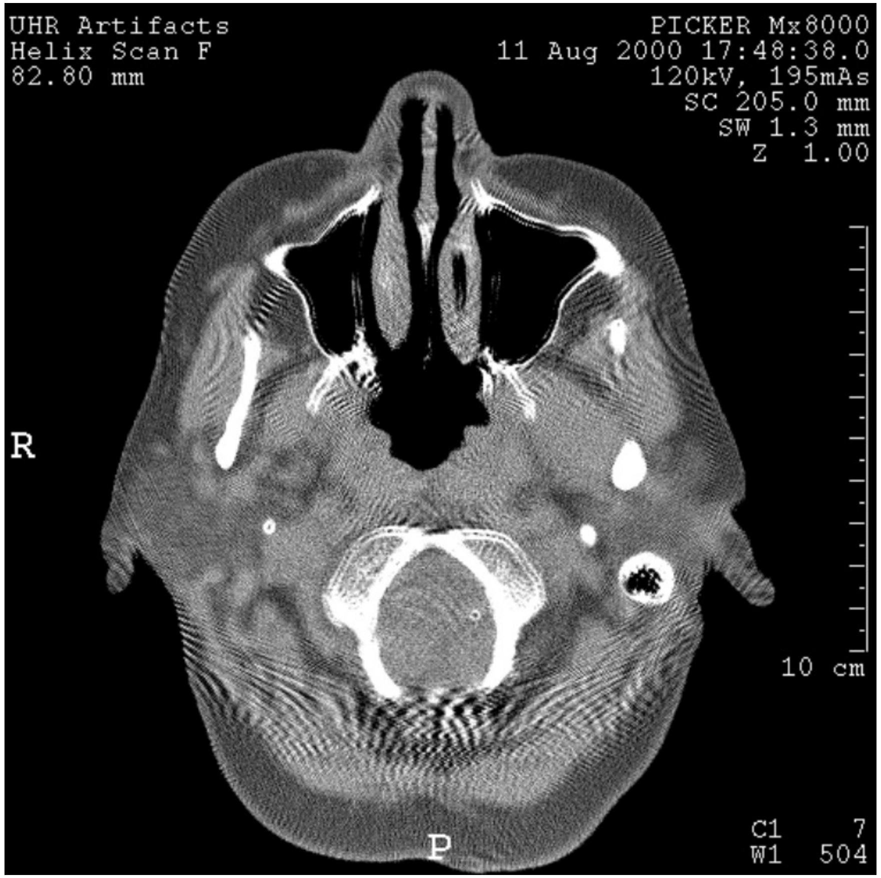

UHR Artifacts
Helix Scan F
82.80 mm
PICKER Mx8000
11 Aug 2000 17:48:38.0
120kV, 195mAs
SC 205.0 mm
SW 1.3 mm
Z 1.00
R
10 cm
P
C1 7
W1 504

Figure 15-5: Bad UH Image

Tools Required:

- Standard FSE toolkit
- Axis pin—provided with each system
- X-ray filmstrip 6 cm width, P/N 780 0100 0032 or FB000100032 request 6 meter 19.6 ft.) length when ordering)
- Torque meter tool

Adjustment Procedure

1. High resolution DFS calibration
2. Ultra high-resolution calibration
3. Ultra High Resolution pre-alignment with X-Ray film

High Resolution DFS Calibration

NOTE:

The Ultra-High collimator mechanical adjustment is accurate if the Axes for high resolution are accurate and if the image quality for high-resolution mode is good (no rings artifacts in the center, and no bad detectors are listed in the bad detector list).

1. Perform Air Calibrations with the following parameters:
    - Voltage: 120 kV
    - Resolution: STD, High
    - SW: 4x5
    - Scan Time: 0.5 & 0.75 sec.
2. Install the axis pin 5cm off center in the down direction.
3. Reset the in/out display to ZERO.

NOTE:

Not resetting the in \ out display to zero causes inaccurate output.

NOTE:

If the tube or XRS parts are replaced, it is recommended to start with Fast Automatic DFS calibration. This calibration updates **All** scan modes (DFS parameters) upon completion. If you choose to perform Fast Automatic DFS calibration, note that you must complete the detailed DFS calibrations for all modes. To perform the High (small FS) DFS, proceed to *Step 5*.

4. From the **Service** menu, select **XRT DFS Alignment**. The XRT Dynamic Focal Spot Calibration Programs and Tests window opens. Click **Calibrate.** In the next window, click **Fast Automatic** and follow the instructions on the screen. Verify that no errors are displayed during the whole process.
5. From the table, select **Detailed -->High Resolution, 120 kV** mode. The program performs DFS Calibration for high-resolution 120 kV only. Verify that no error is displayed and that the program ends successfully.

Ultra High-Resolution Calibration

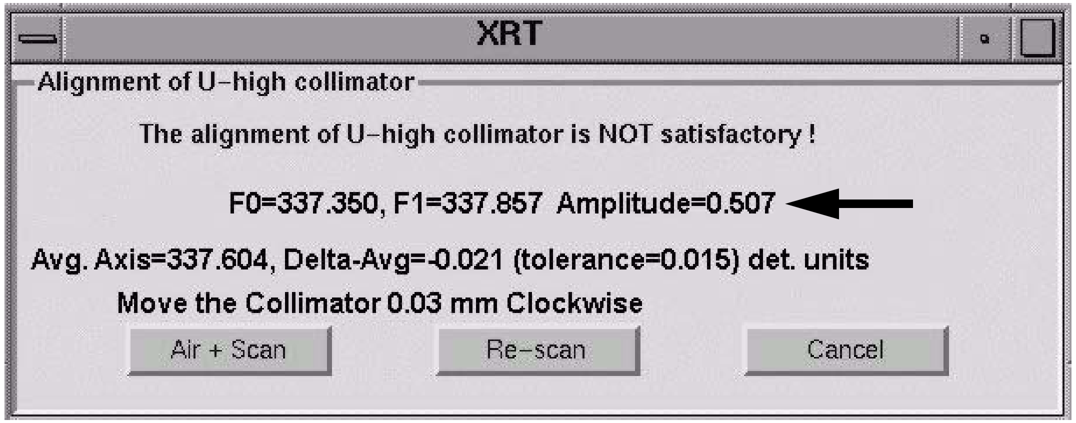
1. Install the axis pin 5 cm off center in the down direction—couch height (v=140).
2. Reset the in/out display to ZERO.

> **NOTE:**
>
> Not resetting the in \ out display to zero causes inaccurate output.

3. From the **Service** menu, select **XRT DFS Alignment**. The XRT Dynamic Focal Spot Calibration Programs and Tests window opens**.** Click **UHR (Air + Scan)**.
   You are requested to click enable twice.

   The program displays the measurement results, and recommends the required collimator movement (in mm) and direction (clockwise or counter-clockwise). *Figure 15-6* shows an example of measurement results as seen on the screen

4. Write down the information regarding collimator movement (note the line in *Figure 15-6* "Move Collimator 0.03 mm Clockwise").



The alignment of U–high collimator is NOT satisfactory !

F0=337.350, F1=337.857 Amplitude=0.507

Avg. Axis=337.604, Delta-Avg=-0.021 (tolerance=0.015) det. units

Move the Collimator 0.03 mm Clockwise

Figure 15-6:

⚠ WARNING

THE FOLLOWING ADJUSTMENT PROCEDURE IS DONE WHILE THE GANTRY FRONT COVER IS OPEN. FOLLOW THE INSTRUCTIONS EXACTLY STEP BY STEP AND COMPLY WITH ALL SAFETY PRECAUTIONS FOR YOUR OWN SAFETY.

5. Move the bed to the maximum out and maximum down position.
6. Remove the pin holder from the bed.
7. Press the stop button on the Gantry. It is important for the adjustment procedure that the system stay in the **stop** stage (it releases the UHR collimator from its locked position).
8. Open the front Gantry cover carefully while observing the mylar gasket. Remove the gasket and place it aside.
9. Turn the Service Switch S-301 OFF (to **0** position).
10. Manually rotate the gantry rotor in the clockwise direction and bring the DMS to a 12 o’clock position (see *Figure 15-7*). Lock the rotor with the locking pin.
11. Proceed to *“Mechanical Adjustment Procedure”*.

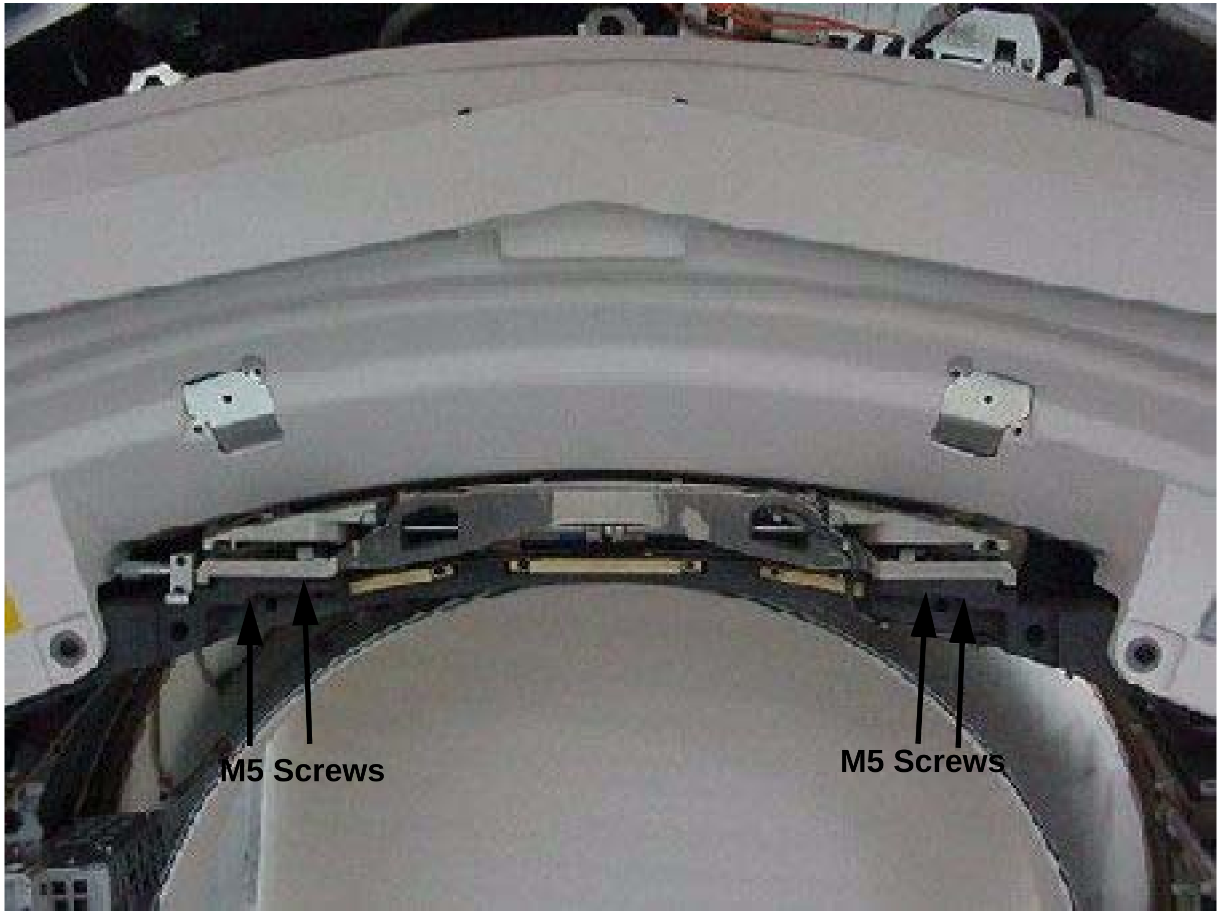

GI/Module #42
(E-Box)
GI/Module #1
(C-Box)
M5 Screws
M5 Screws

Figure 15-7: DMS at the 12 o’clock Position

Mechanical Adjustment Procedure

⚠ CAUTION

THE UHR MECHANISM IS VERY SENSITIVE. FOLLOW THE INSTRUCTIONS CAREFULLY.

The collimator can be moved clockwise or counter-clockwise as required by the program.

1. Read the UHR *x* position with the micrometer as follows:
    a. Bring micrometer face to UHR base. Do **not** apply excessive force.

NOTE:

One complete turn of the thumbwheel equals 0.5 mm. Each division on the thumbwheel equals an increment of 0.01 mm.

    b. Repeat the reading operation three times, to make sure you are reading the same measurement. Note the measurement.
2. Loosen the four M5 screws.
3. Adjust the micrometer to the new, desired position as noted on *page 15-20*, *Step 3*.
4. Push the UHR base left to the micrometer face. Make sure there is no gap between them.

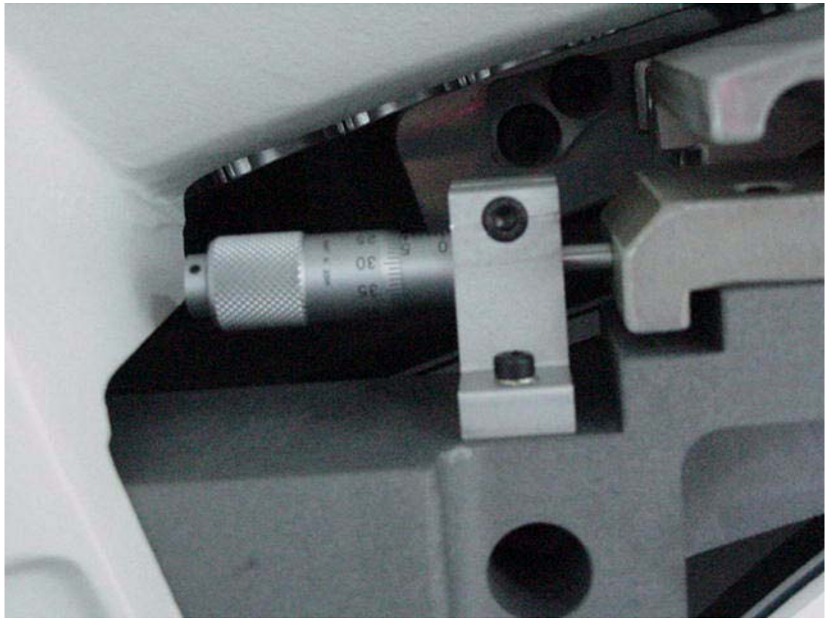


Figure 15-8: UHR Micrometer

5. While you gently push the UHR base to the micrometer face, close the M5 screws with an initial moment of 10 Nm.
6. Repeat with a final moment of 20 Ncm.

Prepare for Retesting

1. Turn the Service Switch S-301 ON (to **1** position).
2. From the **Service** menu, select **MCU Utilities**. Click **Reset MCU.** This brings the gantry to stand-by mode.
3. Close the Gantry front cover.
4. Repeat the procedure from *page 15-20*, *Step 1* until the results are satisfactory.

When done, the alignment of the collimator is satisfactory.

In case the program is unable to converge, and it requires multiple times to move to the same direction with large steps, proceed to *“Ultra High Resolution Pre-alignment with X-ray Film”***.**

Completion Procedure

1. Install the mylar gasket according to TN # 24 (Document CT 2897-024).
2. Lock up the Gantry front cover bolts.
3. Remove the axis pin and holder from the couch.
4. Perform all UHR Air Calibration modes.
5. Perform the following image quality tests for UHR modes:
   - For Mx8000 Quad, see *Table 15-6* and *Table 15-7*.
   - For Mx8000 Dual, see *Table 15-8* and *Table 15-9*.
6. Verify that problem of image artifacts was resolved.

Ultra High Resolution Pre-alignment with X-ray Film

The following procedure may be required if the UHR alignment program is unable to converge successfully. This may be caused when the UHR collimator is shifted CW or CCW by half size of a detector, i.e. 1.4 / 2 = 0.7 mm, or when the UHR collimator base had reached its mechanical limit in one direction.

Preparation for X-ray film Procedure

⚠ WARNING

THE FOLLOWING ADJUSTMENT PROCEDURE IS DONE WHILE THE GANTRY FRONT COVER IS OPEN. FOLLOW THE INSTRUCTIONS EXACTLY STEP BY STEP AND COMPLY WITH ALL SAFETY PRECAUTIONS FOR YOUR OWN SAFETY.

1. Move the couch to the maximum out and maximum down position.
2. Remove the pin holder from the couch.
3. Press the stop button on the Gantry. It is important for the adjustment procedure that the system stay in the **stop** stage (it releases the UHR collimator from its locked position).
4. Open the front Gantry cover carefully while observing the mylar gasket. Remove the gasket and place it aside.
5. Turn the Service Switch S-301 OFF (to **0** position).
6. Manually rotate the gantry rotor CW and bring the DMS to a 12 o'clock position (see *Figure 15-7*). Lock the rotor with the locking pin.

7. Cut a 1.2-meter strip of X-ray film. Taper one end as in *Figure 15-9*. Use tape to tape the edges.
8. Mark the corner by cutting a small cut or little hole with a paper hole-puncher.

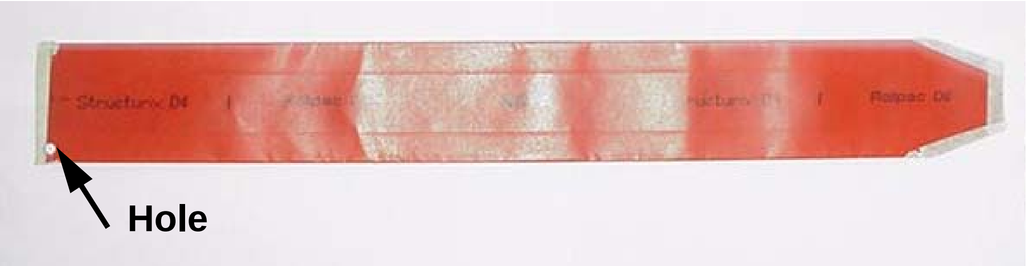


Figure 15-9: Unprocessed X-ray Film

9. Open the covers on each side of the DMS (see *Figure 15-10*). Put the covers and screws aside.

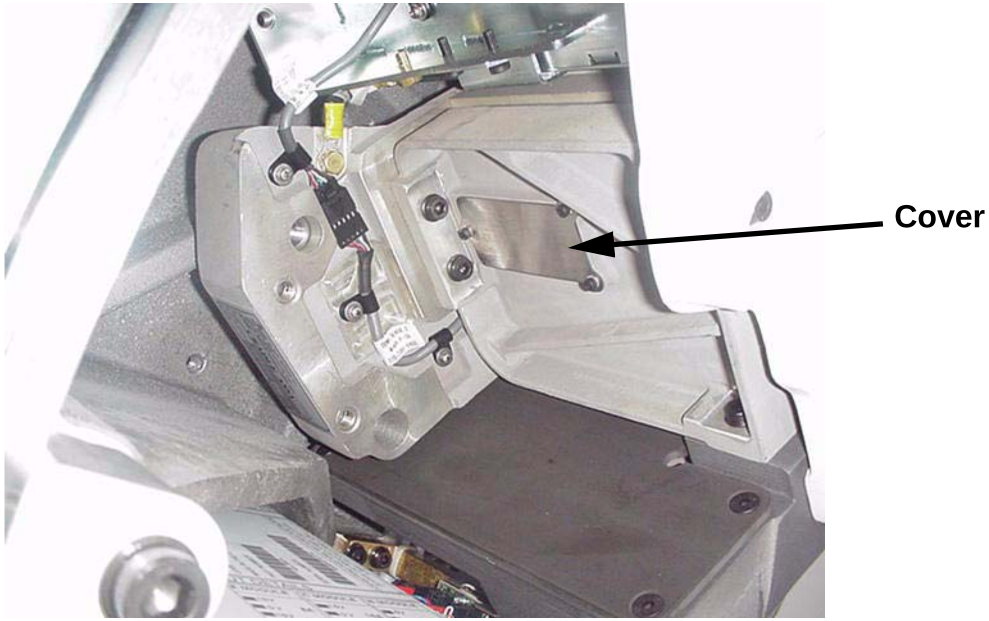


Figure 15-10: DMS Side Cover

10. Insert the film into the DMS from the left side; make sure the punched hole is outside towards you (see *Figure 15-11*).

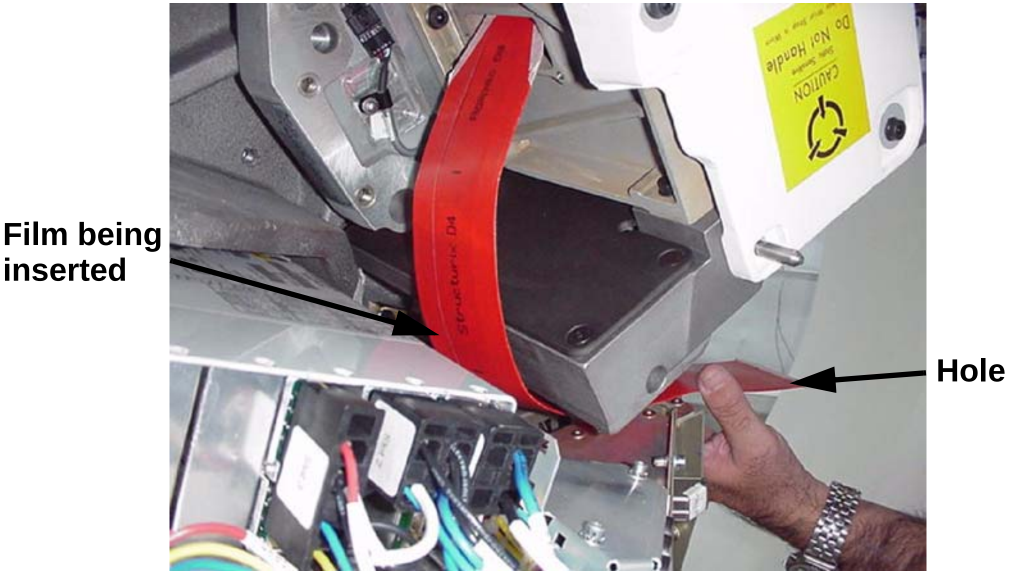


Figure 15-11: Film Insertion

11. From the **Service** menu, select **MCU Utilities**. Click **Reset MCU.** This brings the gantry to stand-by mode.
12. From the **Service** menu, select **Service Parameters**. The Configuration window opens.
    a. Select **Scan Parameters.**
    Set **Gantry Rotation—No**.
    b. set **Diagnostic** level to **2.** Confirm with **OK.**
13. Perform a scan without rotation. Use the parameters in *Step 14*.

⚠ WARNING

VERIFY THAT NO ONE IS IN THE GANTRY ROOM PRIOR TO PERFORMING THE SCAN.

14. Prepare and execute an UHR Head scan protocol with the parameters listed below. Perform five scans and make sure that all five are completed successfully.

UHR HEAD PROTOCOL			
FOV	250mm	Voltage	120kV
Resolution	UHR	Slices	20
Rotation Time	2 sec	Increment	0
mAs	400		

15. Press the **STOP** button.
16. Remove the x-ray film from the DMS. Use the hospital film developer to develop the film. Attach the film to a standard hospital x-ray film to avoid jamming the processor.
17. Observe the central part of the film around detector # 337. The film probably looks as in *Figure 15-12*; the dots might be in the opposite direction. *Figure 15-12* is example to UHR collimator shifted by 0.7 mm in the clockwise direction.

NOTE:

- Hold the film with the marked cut on your **left** side.
- If the dots are opposite to those in *Figure 15-12*, the UHR collimator has shifted 0.7 mm in the counter-clockwise direction.

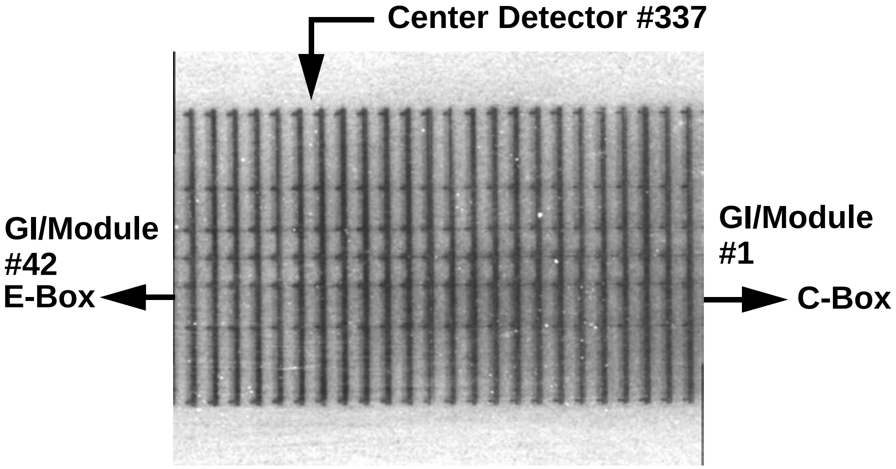


Figure 15-12: Shifted UHR Collimator by half detector width (0.7 mm)

It is very difficult to measure and calculate the exact shift of the collimator. We can only decide in which direction to move the collimator. In the above example we need to move the collimator in the CCW direction. In this case, we recommend you make an initial shift of 0.5 mm (50 small divisions on the micrometer) in the CCW direction. Take a second film and shift the collimator by increments of 0.1 mm each time. When the alignment is very close, shift by increments of 0.05 mm.

The final and correct alignment is displayed as in *Figure 15-13*.

18. Verify that the little black lines (total of seven) are positioned in the center between two shaded vertical lines. The little black lines represent the adjacent gluing between detectors in the Z direction.
19. After the UHR collimator is aligned by film, the automatic program in the system should be able to converge and complete the alignment procedure.
20. Replace the side covers and screws removed in *Step 9*.
21. Return to *“Ultra High-Resolution Calibration”* and continue the UHR calibration program.

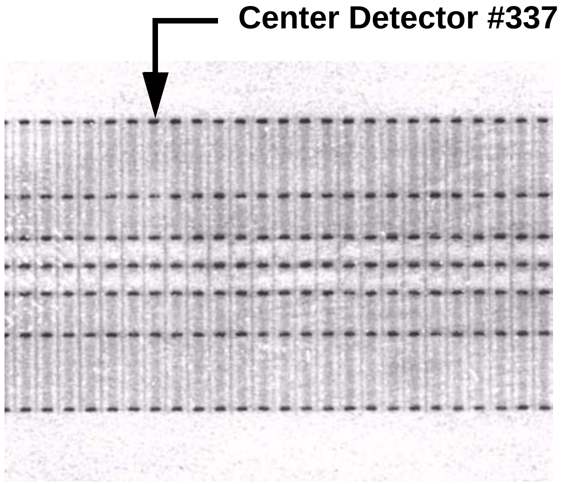


Figure 15-13: Good Alignment

Other Artifacts

Arcing Problems

Arcing can cause artifacts in the image. It is visible on all four slices and it might be a tube or XRS problem.

Check the CanPro file (T-5E) for arcing information.

Reconstruction Problems

These problems can occur in one or more scan modes. This is not an image quality problem, although it may seem that way.

To verify that it is a reconstruction problem:

1. Try to reconstruct a Raw stored previously in the IRS or EOD. If the image is also bad, the system has reconstruction problems.
2. Store the Raw on EOD or transfer it via FTP to another system and reconstruct it there. If the image is OK, your system has a reconstruction problem.

NOTE:

The Raw Data is without the Air calibration so that it might have ring artifacts when reconstructing in another system.

Software Problems

Software corruption could cause the images in a certain mode to be bad while all other modes are OK. For example: Only Head STD 120 kV are bad with many bands and rings. As seen in *Figure 15-14*, repetition of the Air and Phantom calibration did not solve the problem.

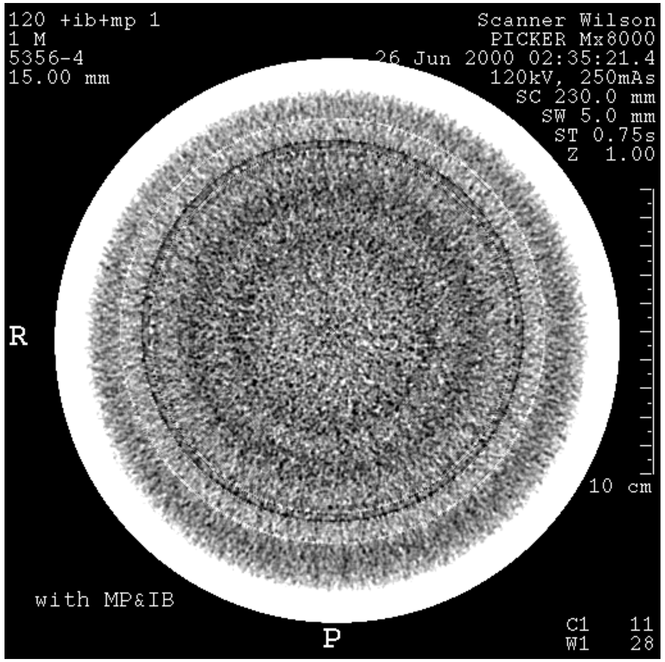

120 +ib+mp 1
1 M
5356-4
15.00 mm
Scanner Wilson
PICKER Mx8000
26 Jun 2000 02:35:21.4
120kV, 250mAs
SC 230.0 mm
SW 5.0 mm
ST 0.75s
Z 1.00
R
10 cm
with MP&IB
P
C1 11
W1 28

Figure 15-14: Bad Image

Solution: Perform IRS SCSI format.

FEE Bias Test

General

This test is part of the nominal software version. It is used if there are unstable rings on the image, e.g., rings that appear intermittently or streak artifacts.

The Bias is the measured output signal at the GI channel when there is no input signal.
A pre-measurement (=Bias) is performed prior to the scan (regardless if the scan is with or without x-ray).

The FEE Bias test checks the Bias values, noise, and leakage. A faulty GI card or module may cause the FEE Bias test results to be outside the limits as in *Figure 15-15*.

NOTE:

- The test is performed with and without x-ray.
- For Ref Det check, see *“Reference Detector Assembly Check”*.

FEE Bias, Noise, Leakage, and, Signal Test Instructions

Scans Without X-ray

Setup

1. From the **Service** menu, select **Service Parameters**. The Configuration window opens.
    a. Select **Recon Parameters**.
    Set **Raw Mode—RAW - for diagnostic only**.
    b. Select **Scan Parameters**.
    Set **Scan with X-ray—No.**
    Set **Diagnostic level—1**. Confirm with **OK**.
2. Perform two scans with the scan parameters from *Table 15-3*; one with 4 x 5 mm thickness and one with 4 x 1 mm thickness.

Table 15-3:

AXIAL HEAD PROTOCOL			
FOV	500mm	**Voltage**	120kV
Resolution	STD	**Filter**	EB
Rotation Time	0.75 sec	**Matrix**	512x512
mAs	170		

NOTE:

You must type in the value for mAs (170) manually.

3. From the **Service** menu, select **FEE Bias**. The FEE Bias Test window opens. Load the Raw Data from the **IRS** archive.

NOTE:

The software automatically identifies the type of raw data, e.g. with/without x-ray.

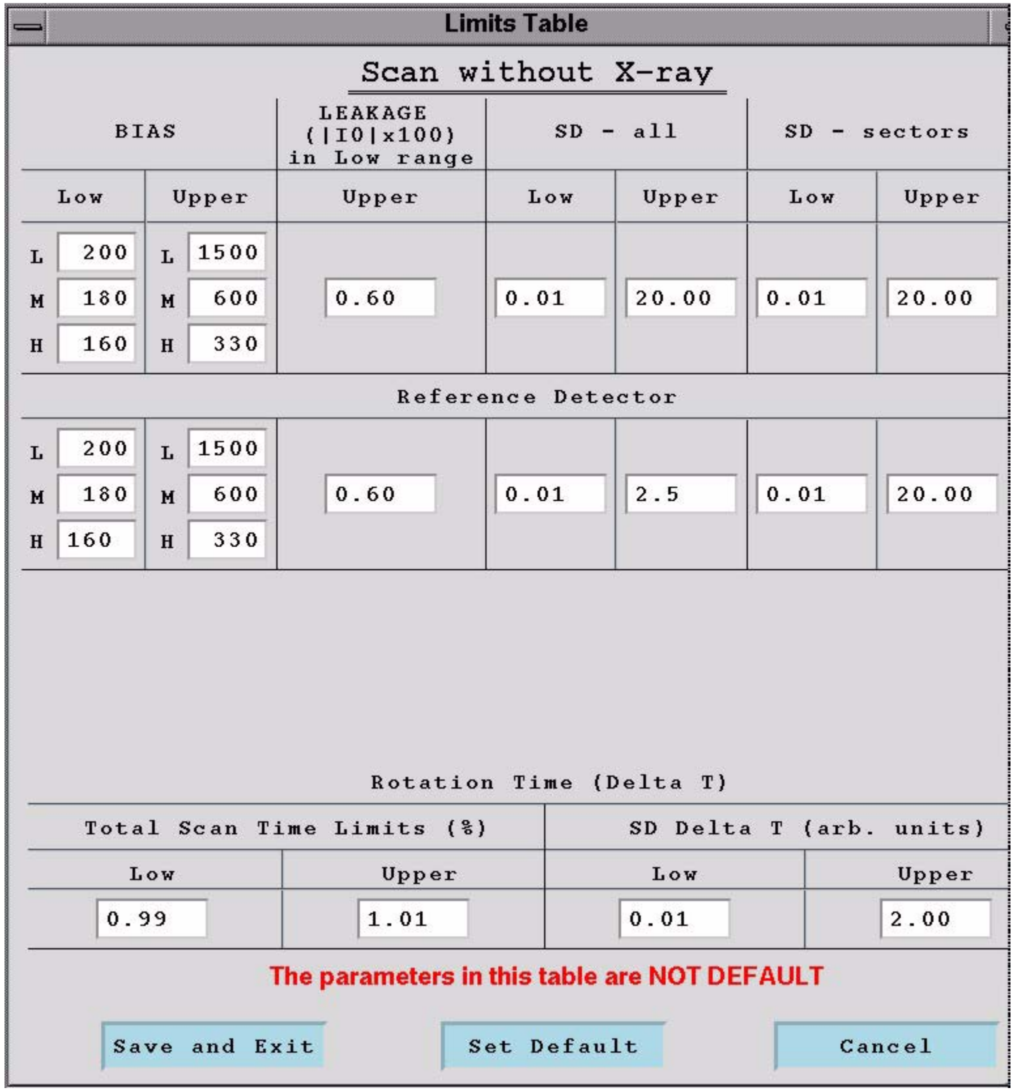
4. In the FEE Bias Test window, click **Without X-ray** and set the Limits Table as in *Figure 15-15*.
   Click **Save and Exit**.

   The program tests the following parameters for all channels and for all slices for averaged focal spots:

- Bias, Noise, and Leakage
- Reference Detector Bias, Noise, and Leakage

NOTE:

Test reference detector at slice width 4x5 only.



Scan without X-ray

BIAS		LEAKAGE (|I0|x100) in Low range	SD - all		SD - sectors	
Low	Upper	Upper	Low	Upper	Low	Upper
L 200	L 1500					
M 180	M 600	0.60	0.01	20.00	0.01	20.00
H 160	H 330					
Reference Detector						
L 200	L 1500					
M 180	M 600	0.60	0.01	2.5	0.01	20.00
H 160	H 330					

Rotation Time (Delta T)

Total Scan Time Limits (%)		SD Delta T (arb. units)	
Low	Upper	Low	Upper
0.99	1.01	0.01	2.00

The parameters in this table are NOT DEFAULT

Figure 15-15: Limits Table without X-ray

5. Click **Check All**. The displayed data is numerical values. For a graphic plot of each slice, click **Plot Data**.

The source for rejected results can be at least one of the following: GI card, Anti-scatter, or cable cleaning.

In case of rejected results in the following,

- Bias—Usually GI card problem
- Noise—Usually solved by cleaning the module cable or it can be light leakage
- Light Leakage—Always a module problem—replace the module

check the following in the order listed:

1. GI card for Biases
2. Light leakage
3. Detector module cleaning

For cleaning process, see *“Cleaning Detector QS Modules with ACL Staticide Wipes SW-12”*.

NOTE:

- The procedure below can be used as is for modules not in the center position (19–24).
- It is possible to swap a modules in any position in the DMS except for modules in the center position (19–24). **Do not swap modules in the center position even for diagnostic purposes!**
- If the problem is not a GI card, replace **all** six modules. See *“Replacing a Six Module Set”* for further instructions.

If a problem is found in any test:

1. Swap the GI card or detector module and perform a scan to identify the faulty part.
2. Replace either the GI card or the detector module.

If there is a problem with the anti-scatter grid, light leakage may be found at end detectors (the first or the last in the module). This can be determined in the following ways:

1. Check the Prep data (leaking light appears as dark lines along the detector).
    a. The SD (Standard Deviation) noise in a module with a light leakage problem is very high and is outside the limits as in *Figure 15-15*. Perform a scan without rotation while the GI card is disconnected from its module.
    From the **Service** menu, select **Service Parameters**. The Configuration window opens.
    b. Select **Scan Parameters.**
    Set **Gantry Rotation—No**.
    Set **Diagnostic** level to **2**. Confirm with **OK.**

    If this effect exists it does not appear with disconnected GI card.

Remove modules with light leakage for repair at PMSTL Repair Center.

NOTE:

See *“Reference Detector Assembly Check”* and *“Replacing a Six Module Set”* for calibrations to be done after GI card or module replacement.

Scans in Air With X-ray

Setup

1. From the **Service** menu, select **Service Parameters**. The Configuration window opens.
   a. Select **Recon Parameters**.
   Set **Raw Mode—RAW - for diagnostic only**.
   b. Select **Scan Parameters**.
   Set **Diagnostic level**—**2**. Confirm with **OK**.
2. Perform two scans; scan parameters are the same as defined for **no x-ray** (see *Table 15-3***).**

NOTE:

Test reference detector at slice width 4x5 only.

3. From the **Service** menu, select **FEE Bias**. The FEE Bias Test window opens. Load the Raw Data from the **IRS** archive.

4. In the FEE Bias Test window, click **With X-ray** and set the Limits Table as in *Figure 15-16*.
   Click **Save and Exit**.

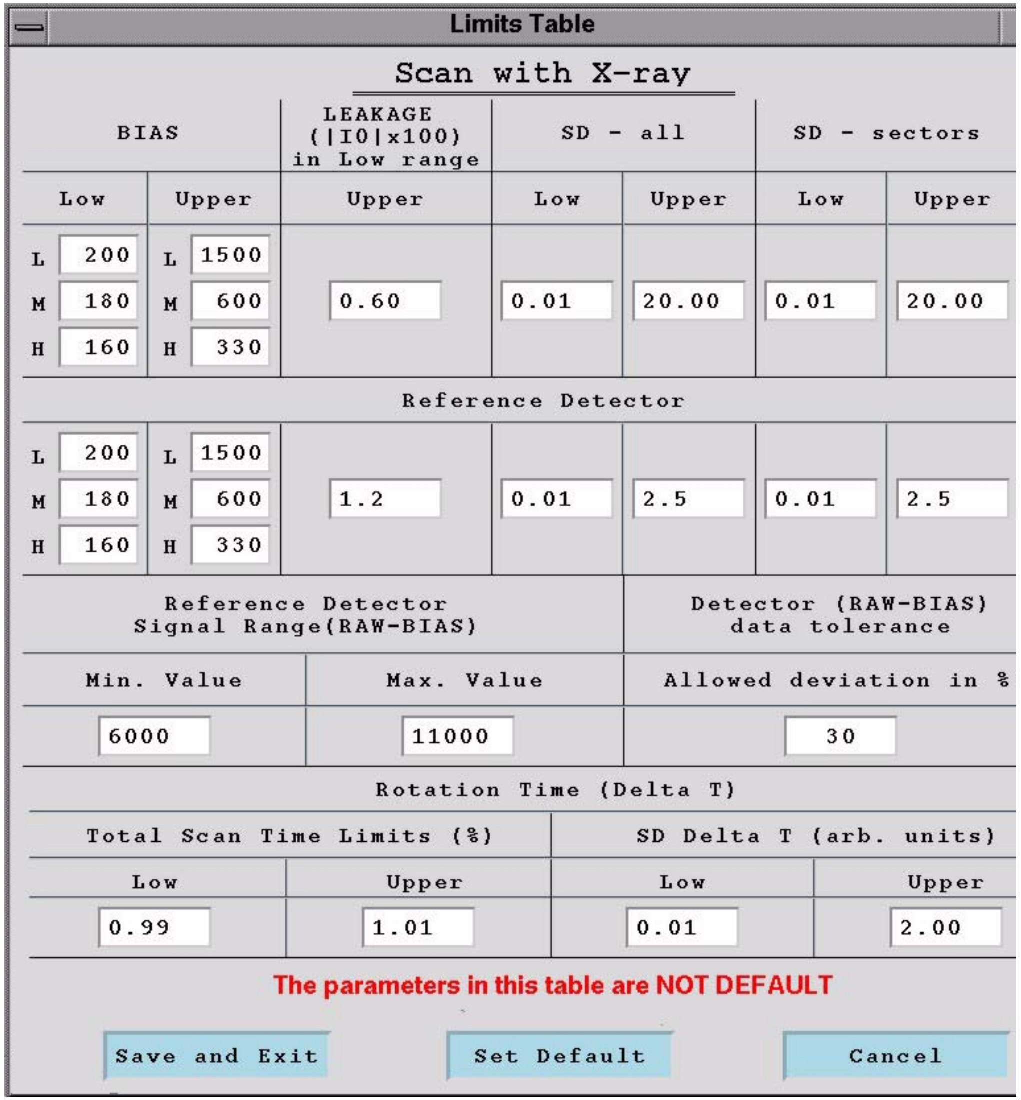
The program tests the different parameters for all channels, for all slices, for averaged focal spots, and averaged frames.

5. Click **Plot** to see the signal of all the slices.

NOTE:

For reference detector readings, click **Check Delta R**. Observe rejections in the Result Table window.

For more details, click **Raw Bias** in the Analysis window. From the Data table, select **DeltaR/Delta/T**. Click **Statistics**.



Scan with X-ray

BIAS				LEAKAGE (|I0|x100) in Low range	SD - all		SD - sectors	
Low		Upper		Upper	Low	Upper	Low	Upper
L	200	L	1500					
M	180	M	600	0.60	0.01	20.00	0.01	20.00
H	160	H	330					
Reference Detector								
L	200	L	1500					
M	180	M	600	1.2	0.01	2.5	0.01	2.5
H	160	H	330					

Reference Detector Signal Range(RAW-BIAS)		Detector (RAW-BIAS) data tolerance
Min. Value	Max. Value	Allowed deviation in %
6000	11000	30

Rotation Time (Delta T)

Total Scan Time Limits (%)		SD Delta T (arb. units)	
Low	Upper	Low	Upper
0.99	1.01	0.01	2.00

The parameters in this table are NOT DEFAULT

Figure 15-16: Limits Table With X-ray

NOTE:

- For signal check refer to the deviation of separate channels or group of channels from the neighbor channels on the plot itself.
- Neglect rejects by the program if the limit lines are misplaced by the program.
- The criteria for signal rejects is defined in *Figure 15-15*.

NOTE:

Disregard Channel 1 readings. They are not relevant (not used).

NOTE:

After you complete all tests, set all parameters back to default.

Reference Detector Assembly Check

General

The raw data is normalized by the Reference Detector (ref det). A fault in the ref det may cause a bad image or no image at all.

The ref det channel is tested by performing a scan with and without x-ray:

- Scan with x-ray—for its signal values
- Scan without x-ray—for its bias values

Procedure

Scans Without X-ray

Setup

1. From the **Service** menu, select **Service Parameters**. The Configuration window opens.
   a. Select **Recon Parameters**.
   Set **Raw Mode—RAW - for diagnostic only**.
   b. Select **Scan Parameters**.
   Set **Scan with X-ray—No**.
   Set **Diagnostic level—1**. Confirm with **OK**.
2. Perform two scans with the scan parameters from *Table 15-4*.

Table 15-4:

AXIAL HEAD PROTOCOL			
Thickness	4x5	**Voltage**	120kV
Resolution	STD	**Filter**	EB
Rotation Time	0.75 sec	**Matrix**	512x512
mAs	170		

3. View the **Measured Bias** (B1L) as follows:
   a. From the **Service** menu, select **Analysis.** In the Analysis window, click **Archive**, and then, in the Archives Manager window, click on the **IRS** icon. Select the desired Raw/Prep data and then click **OK**.
   b. In the Analysis window, click **Raw/Bias**. In the Data list, select **Measured Bias**. Click **Data**.

> **NOTE:**
>
> **THE ALLOWED RANGE IS:** 200 < B1L < 1500

4. View the Leakage Current as follows:
   In the Analysis window, click **Raw/Bias**. In the Data list, select **Calculated Bias**. Click **Data**.

> **NOTE:**
>
> **THE ALLOWED RANGE IS:** IOL * 1000 <1.2

5. View the SD (Standard Deviation) as follows:
   In the Analysis window, click **Raw/Bias**. In the Data list, select **Statistic.**

> **NOTE:**
>
> **THE ALLOWED RANGE IS:** SD <2.5

If the values are not in range in steps 3–5, the fault may be with the Reference Detector, Ref Det Amplifier, or the GI Ref Board.

To find the faulty part, disconnect the Reference Detector from its amplifier.

NOTE:

Secure any loose cables that were disconnected.

6. Repeat the scan performed in *Step 1* and check *Step 3*–*Step 5*. If the results are OK, replace the Reference Detector.
7. If not, disconnect the cable between the GI Ref board and the amplifier. Repeat the scan performed in *Step 1* and *Step 3*–*Step 5*. If the values are in range, replace the Reference Detector Amplifier. If the values are not in range, replace the GI Ref board.

NOTE:

Connect all cables previously disconnected.

Scan With X-ray

1. At the **Service** -->**Service Parameters**, set the following:

   At **Scan Parameters** set:
   Scan with x-ray—yes

2. Perform a scan **in air** with the following scan parameters:

Table 15-5:

AXIAL HEAD PROTOCOL			
Thickness	4x5	**Voltage**	120kV
Resolution	STD	**Filter**	EB
Rotation Time	0.75 sec	**Matrix**	512x512
mAs	170		

3. From the **Service** menu, select **Analysis.** In the Analysis window, click **Archive**, and then, in the Archives Manager window, click on the **IRS** icon. Select the desired Raw/Prep data and then click **OK**.
4. In **Analysis** check the value of Delta R-Bias. This is the signal value of the Ref Det channel. Click **Raw/Bias**. From the Data list, select **Delta T/Delta R** and then click **Statistics.**

NOTE:

THE ALLOWED RANGE IS: 6000–11000L

If the values are not in the above range, the fault may be with the Reference Detector, Ref Det Amplifier, or the GI Ref Board.

NOTE:

After you complete all tests, set all parameters back to default.

Replacing a Six Module Set

This section relates to the six module set in positions 19–24 in the DMS.

The part numbers for the six module set are as follows:

- Mx8000 Quad—P/N 407-7181-4403
- Mx8000 Dual—P/N 407-7182-1408

General

Replacement of the six module set is to be performed in case there is a problem in one or more of the center detectors. This set is sorted and checked for position and image quality. Replacing by sets is the best solution for center detectors artifacts.

NOTE:

You must assemble each replacement module in its proper position in the DMS.

Procedure

The procedure for replacing a single module detector is described in *“Replacing Single Detector Modules”*.

⚠ CAUTION

TAKE CARE NOT TO DAMAGE THE SIDE LEAVES BY USING TOO MUCH FORCE WHEN REMOVING OR INSTALLING MODULES. DAMAGE TO THE SIDE LEAVES CAUSES THE MODULE TO BE DEFECTIVE.

After the modules are replaced:

1. Close all the Gentry covers and let the Gantry rotate for at least ten minutes for temperature stabilization (check the temperature with the CANpro program by the UCC telegram).
2. Perform phantom calibrations including static air calibrations.
3. Perform air calibration for all modes.
4. Perform image quality check.
5. For testing results see the following:
   - For Mx8000 Quad, see *Table 15-6* and *Table 15-7*.
   - For Mx8000 Dual, see *Table 15-8* and *Table 15-9*.

Table 15-6: Mx8000 Quad Testing Results - Head Protocol, FOV 250 mm, 512 matrix, 20 mm UP

PHANTOM	SCAN PARAMETERS KILOVOLT, SW, RESOLUTION, ROT. TIME, mAs, FILTER	CT SLICE A	CT SLICE B	CT SLICE C	CT SLICE D	ALLOWED CT NO.
Head pins	120kV, 4×2.5, High, 0.75s, 245 mAs, C					±4
Head pins	120kV, 4x5, STD, 0.75s, 250 mAs, B, **with Ultra Image**					±4
Head water	120kV, 2x8, STD, 0.75s, 250 mAs, EB			N/A	N/A	±4
Head water	120kV, 4x5, STD, 0.75s, 250 mAs, EB					±4
Head water	120kV, 4x2.5, STD, 0.75s, 250 mAs, EB					±4
Head water	120kV, 4x1, STD, 0.75s, 300 mAs, C					±6
Head water	120kV, 2x0.5, STD, 1.5s, 350 mAs, EB			N/A	N/A	±10
Head water	120kV, 4x2.5, U-high, 1.0s, 300 mAs, B					±6
Head pins	120kV, 4x1, U-high, 1.0s, 300 mAs, C					±6
Head pins	120kV, 2x0.5, U-high, 1.5s, 300 mAs, C			N/A	N/A	±10
Head water	120 kV, 4×5, STD, 0.5s, 250 mAs, EB					±4

Table 15-7: Mx8000 Quad Testing Results - Body Protocol, FOV 350 mm, 512 matrix, 30 mm UP

PHANTOM	**SCAN PARAMETERS KILOVOLT, SW, RESOLUTION, ROT. TIME, mAs, FILTER**	**CT SLICE A**	**CT SLICE B**	**CT SLICE C**	**CT SLICE D**	**ALLOWED CT NO.**
Body	120kV, 2x8, STD, 0.75s, 300 mAs, B			N/A	N/A	±4
Body	120kV, 4x5, STD, 0.75s, 300 mAs, B					±4
Body	120kV, 4×2.5, STD, 1.0s, 300 mAs, B					±4
Body	140kV, 4x5, STD, 1.5s, 300 mAs, B					±4
Body	120kV, 4x5, STD, 2.0s, 300 mAs, B					±4
Body	120kV, 4x5, STD, 0.5s, 250 mAs, B					±4
Body	90kV, 4x1, STD, 1.0s, 250 mAs, B					±6
Body	140kV, 4x2.5, High, 1.0s, 250 mAs, B					±4
Body	120 kV, 4x1, STD, 0.75s, 100 mAs, B					±6
Body	140kV, 4x2.5, U-High, 1.5s, 400 mAs, B (FOV=250 mm)					±4
Body	120kV, 4x5, STD, 0.75s, 200 mAs, B FOV=500mm, Phantom MAX Down					N/A
SURVIEW SCAN, 500 MM LENGTH						
Body	120kV, 30 mA, Scan angle 180°, Weight factor D (Check if OK)					N/A

Table 15-8: Mx8000 Dual Testing Results - Head Protocol, FOV 250 mm, 512 matrix, 20 mm UP

PHANTOM	SCAN PARAMETERS KILOVOLT, SW, RESOLUTION, ROT. TIME, mAs, FILTER	CT SLICE A	CT SLICE B	ALLOWED CT NO.
Head pins	120kV, 2×2.5, High, 0.75s, 245 mAs, C			±4
Head pins	120kV, 2x5, STD, 0.75s, 250 mAs, B, **with Ultra Image**			±4
Head water	120kV, 2x10, STD, 0.75s, 250 mAs, EB			±4
Head water	120kV, 2x8, STD, 0.75s, 250 mAs, EB			±4
Head water	120kV, 2x5, STD, 0.75s, 250 mAs, EB			±4
Head water	120kV, 2x2.5, STD, 0.75s, 250 mAs, C			±4
Head water	120kV, 2x1, STD, 0.75s, 300 mAs, C			±6
Head water	120kV, 2x0.5, STD, 1.5s, 350 mAs, EB			±15
Head water	120kV, 2x2.5, U-high, 1.0s, 300 mAs, B			±10
Head pins	120kV, 2x1, U-high, 1.0s, 300 mAs, D			±10
Head pins	120kV, 2x0.5, U-high, 1.0s, 300 mAs, C			±10
Head water	120 kV, 2×5, STD, 0.5s, 250 mAs, EB			±4

Table 15-9: Mx8000 Dual Testing Results - Body Protocol, FOV 350 mm, 512 matrix, 30 mm UP

PHANTOM	SCAN PARAMETERS KILOVOLT, SW, RESOLUTION, ROT. TIME, mAs, FILTER	CT SLICE A	CT SLICE B	ALLOWED CT NO.
Body	120kV, 2x10, STD, 0.75s, 300 mAs, B			±4
Body	120kV, 2x8, STD, 0.75s, 300 mAs, B			±4
Body	120kV, 2x5, STD, 0.75s, 300 mAs, B			±4
Body	120kV, 2x2.5, STD, 1.0s, 300 mAs, B			±4
Body	140kV, 2x5, STD, 1.5s, 300 mAs, B			±4
Body	120kV, 2x5, STD, 2.0s, 300 mAs, B			±4
Body	120kV, 2x5, STD, 0.5s, 250 mAs, B			±4
Body	90kV, 2x1, STD, 1.0s, 250 mAs, B			±6
Body	140 kV, 2x2.5, High, 1.0s, 250 mAs, B			±4
Body	120kV, 2x1, STD, 0.75s, 100 mAs, B			±6
Body	140kV, 2x2.5, U-High, 1.5s, 400 mAs, C (FOV=250 mm)			±4
Body	120kV, 2x5, STD, 0.75s, 200 mAs, B FOV=500mm, Phantom MAX Down			N/A
SURVIEW SCAN, 500 MM LENGTH				
Body	120kV, 30 mA, Scan angle 180°, Weight factor D (Check if OK)			N/A

Bad Detector Table

The system has a Bad Detector table. It is mainly a diagnostic tool. Do not work with a bad detector identified in the table. It can cause artifacts in various scan modes.

NOTE:

The system disregards the bad detector table while performing phantom and air calibrations. Therefore, a ring may be seen on the image even if a detector is defined as bad.

GI Card Replacement

After replacing a GI card, perform the following calibrations:

NOTE:

Close all the Gentry covers and let the Gantry rotate for at least ten minutes for temperature stabilization.

- A center GI—air calibration and phantom calibration (position 19–24 in the DMS).
- GI not in center—air calibration.

A Band on Body Image

There is a possibility of streak artifacts appearing on an image on surview scans. The surview is performed by using low mAs. The cause of the problem can be a defective GI card. To clarify the problem, perform a body axial scan with the following parameters:

Body Phantom Protocol

- Voltage: 120 kV
- Rotation Time: 0.5 sec.
- SW: 4x1
- mAs: 50

If a band is seen on the image and not seen in other slice widths (4x2.5 mm, 4x5 mm), identify the faulty GI using **Analysis** or **Raw to Filter Reconstruction,** and replace the faulty GI. For GI replacement, *"GI Card Replacement"*.

Phantom Calibration

Verify that DFS and axis calibration are within tolerance before performing phantom calibration.

Single Module Replacement

A single spare module is Class B. It is to be used for any position except the six center modules.

The part numbers for the six module set are as follows:

- Mx8000 Quad—P/N 407-7181-8107
- Mx8000 Dual—P/N 407-7182-1606

Cleaning Detector QS Modules with ACL Staticide Wipes SW-12

Introduction

This procedure is to be performed in the event that the image has rings or streaks. Performing the FEE Bias test (*"FEE Bias, Noise, Leakage, and, Signal Test Instructions"*) indicates channels with SD noise above the upper limits. In this case, cleaning the detector module cables can remove the electrostatic charge accumulated on the detector cable.

General

The cleaning should be done before assembling the QS module on the DMS, but it is also possible to clean the module after it is already assembled in the DMS. During the process, the worker must be ESD protected.

⚠ CAUTION

FOLLOW ALL ESD PROTECTION GUIDELINES OUTLINED IN SECTION *"ESD (Electrostatic Discharge)"*.

⚠ CAUTION

NO CONTACT IS ALLOWED BETWEEN THE ACL AND THE DETECTORS BOARD AND THE CONNECTOR.

Safety Measures When Using ACL

The ACL is a non-toxic material. However the solution may irritate eyes and may be harmful or fatal if swallowed.

- Cleaning the module cables can be done while the module is still attached to the DMS.
- The module cables are loose for the time that is required for cleaning.

WARNING

LOCK THE ROTOR DURING THE CLEANING PROCEDURE TO PREVENT IT FROM ROTATING.

First Aid Measures

- Skin: Wash with soap and water
- Eye: Flush with water. Contact a physician if necessary
- Inhalation: Remove to fresh air and contact physician if necessary
- Ingestion: Drink copious amounts of water/milk and contact physician
- General Advice: Do not smoke while using, keep away from children, wash hands after using

Cleaning Procedure

Preparations

1. Stop Gantry motion.
2. Remove the head holder attached to the bed.
3. Move the bed to the outer limit and lower it to its minimum height.
4. Open the Gantry front cover.
5. Position the DMS to the 12 o’clock position.
6. Switch OFF all Gantry power.
7. Switch OFF Circuit Breaker F9 (DMS power).
8. Open the DMS cover. Be sure to disconnect the temperature sensor cables and the power connector for the fans.
9. Place the cover with its six screws in a safe place.

Cleaning

1. Loosen the screws that connect the flexible/rigid cable to the detector module that needs cleaning. Clean only those that do not pass the FEE Bias Test (*"FEE Bias Test"*). Leave the connector dangling (see *Figure 15-17*).

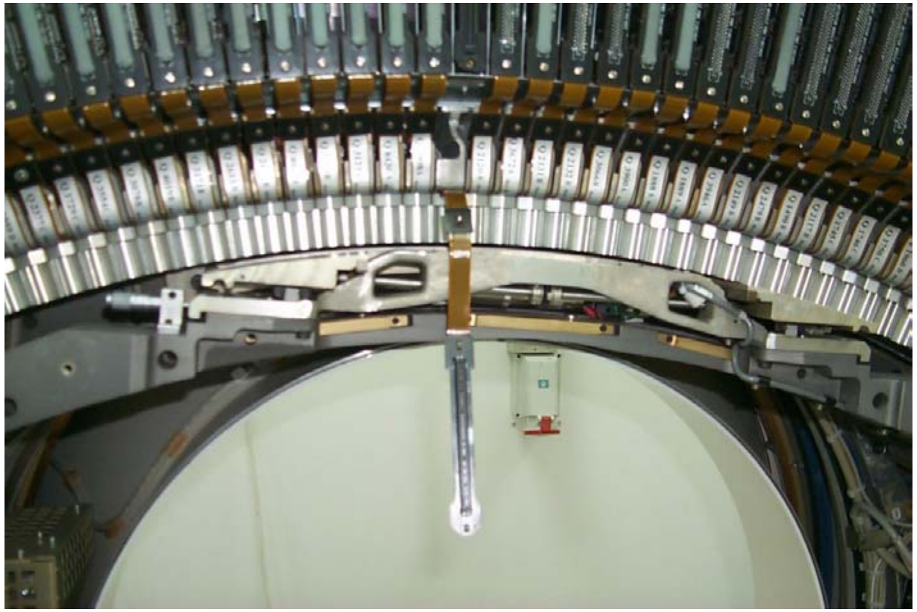


Figure 15-17:

NOTE:

Use one or two ACL Staticide Wipes SW-12 for each module to be cleaned.

NOTE:

- Use antistatic rubber finger protection P/N ZT01310100L while cleaning the cables.
- The cleaning solvent evaporates in about 7–10 minutes. Open the wipes only prior to cleaning.
- When cleaning make sure that the wipe does not disintegrate. If it does, take a new one right away. Particles from the wipe can cause noise problems.

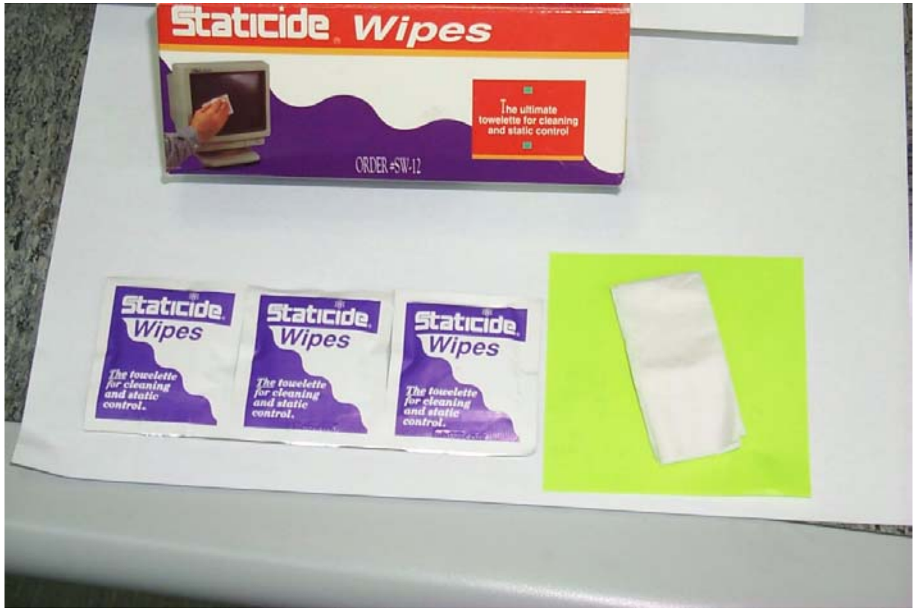

Staticide Wipes
The ultimate towelette for cleaning and static control
ORDER #SW-12
Staticide Wipes
The towelette for cleaning and static control.
Staticide Wipes
The towelette for cleaning and static control.
Staticide Wipes
The towelette for cleaning and static control.

Figure 15-18: ACL Staticide Wipes

2. Clean both external layers of the module cable and between the layers (see *Figure 15-19*).

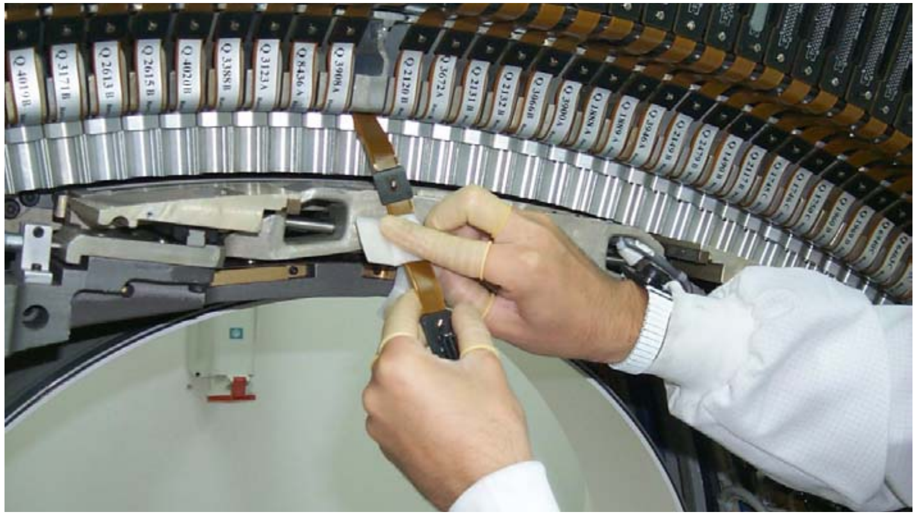


Figure 15-19:

3. Repeat item 2 for the section of the cable between the rigid part and the detector board (see *Figure 15-20*).
4. After you complete steps 2 and 3, close the gap between the layers and clean the external layers again.

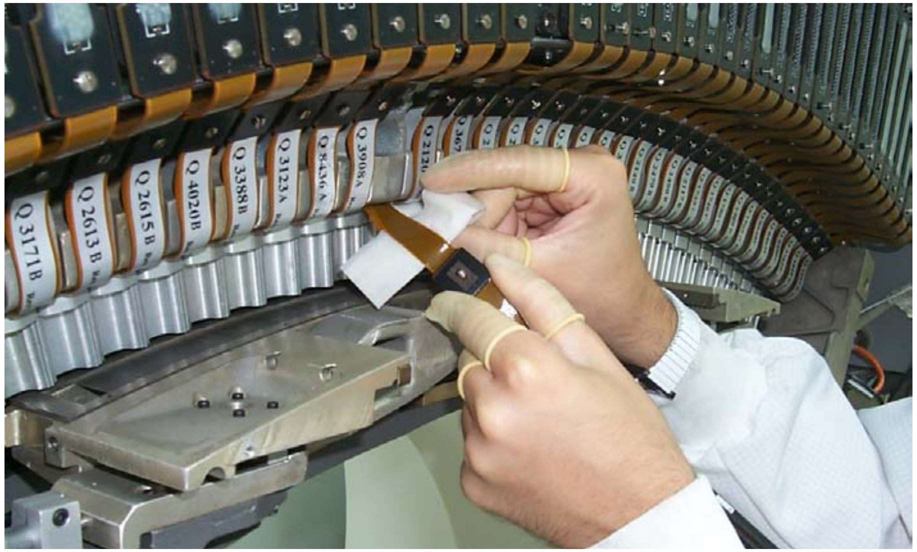


Figure 15-20:

5. To obtain access to the inner layers, tilt the cable as shown in *Figure 15-21*. Repeat *Step 2*–*Step 5* for each module cable to be cleaned.
6. Let the cables dry for 15 minutes.
7. Connect all the cables that you loosened to perform this operation.
8. Close the DMS cover and connect all its cables.
9. Close the Gantry front cover.
10. Turn on Circuit Breaker F9 (DMS power).
11. Switch on Gantry power.
12. Perform the FEE Bias test and check for results. See *"FEE Bias Test"* for instructions.
    If the FEE Bias test results are still not within tolerance, replace the module.

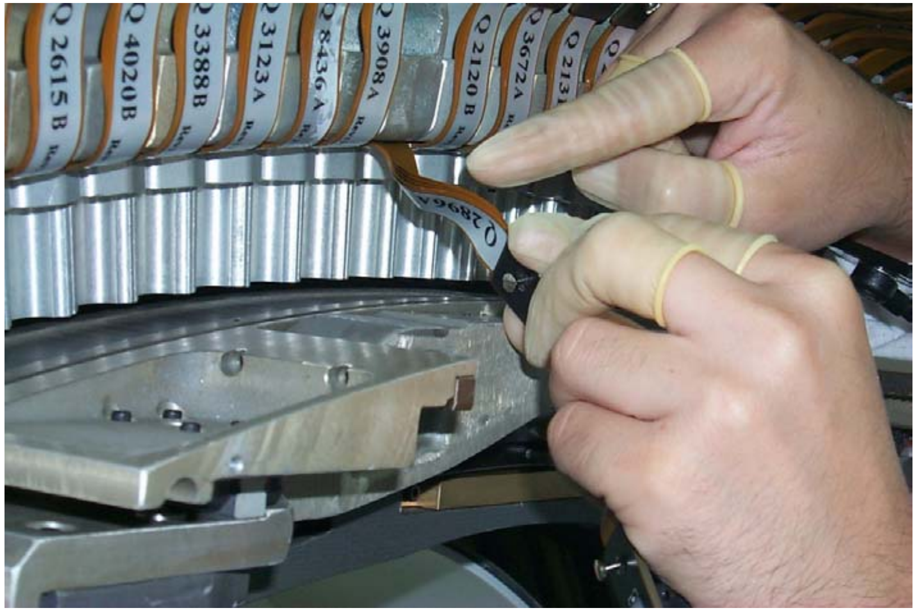


Figure 15-21:

Examples of Real Problems

TEST 4X5		
MODULE NO.	**WITHOUT ACL (STD)**	**WITH ACL (STD)**
1	3.16	1.53
2	2.51	1.63
15	2.54	2.04
18	2.94	1.69
32	2.84	1.54
40	2.67	1.65

TEST 4X1		
MODULE NO.	**WITHOUT ACL (STD)**	**WITH ACL (STD)**
4	7.80	3.08
5	5.13	3.23
9	7.11	3.38
40	16.25	2.94
42	6.43	2.93

GI/Module Table

Use the GI/Module table to locate the channel in a GI/Module with a channel number.

Table 15-10: The GI/Module Table

A/B	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
C/D	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32

1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
2	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
3	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
4	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
5	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
6	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
7	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112
8	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
9	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144
10	145	146	147	148	149	150	151	152	153	154	155	156	157	158	159	160
11	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176
12	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192
13	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208
14	209	210	211	212	213	214	215	216	217	218	219	220	221	222	223	224
15	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240
16	241	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256
17	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272
18	273	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288
19	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304
20	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320
21	321	322	323	324	325	326	327	328	329	330	331	332	333	334	335	336
22	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352
23	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368
24	369	370	371	372	373	374	375	376	377	378	379	380	381	382	383	384
25	385	386	387	388	389	390	391	392	393	394	395	396	397	398	399	400
26	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416
27	417	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432
28	433	434	435	436	437	438	439	440	441	442	443	444	445	446	447	448
29	449	450	451	452	453	454	455	456	457	458	459	460	461	462	463	464
30	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480
31	481	482	483	484	485	486	487	488	489	490	491	492	493	494	495	496
32	497	498	499	500	501	502	503	504	505	506	507	508	509	510	511	512
33	513	514	515	516	517	518	519	520	521	522	523	524	525	526	527	528
34	529	530	531	532	533	534	535	536	537	538	539	540	541	542	543	544
35	545	546	547	548	549	550	551	552	553	554	555	556	557	558	559	560
36	561	562	563	564	565	566	567	568	569	570	571	572	573	574	575	576
37	577	578	579	580	581	582	583	584	585	586	587	588	589	590	591	592
38	593	594	595	596	597	598	599	600	601	602	603	604	605	606	607	608
39	609	610	611	612	613	614	615	616	617	618	619	620	621	622	623	624
40	625	626	627	628	629	630	631	632	633	634	635	636	637	638	639	640
41	641	642	643	644	645	646	647	648	649	650	651	652	653	654	655	656
42	657	658	659	660	661	662	663	664	665	666	667	668	669	670	671	672

Appendix A
Electrical Line Inspection

This contains all the test and corrective action procedures necessary to evaluate the behavior of the electrical line to the system. Note the following information:

- Points and measurements appropriate to the project must be completely filled out in the checklist prior to the installation of the Mx8000 system.
  The project manager must confirm the accuracy of the information by providing his signature.
- The checklist completed by the project manager is to be submitted to the personnel performing the system start-up.
- The personnel performing the system start-up installs the Mx8000, performs the on-site line voltage measurements after the installation and completes the checklist.
  By signing the checklist, the personnel performing the system start-up confirms the accuracy of the information.
- Only after the above has been performed can the system be put into operation. If the checklist is not completely filled out, system start-up cannot take place.

Line Impedance Measurement Kit P/N 453566454111 (PMSTL P/N 407-7181-8008)

The Line Impedance Measurement Kit contains the following:

ITEM	DESCRIPTION	QTY
1	PROFiTEST 0100S-II Line Impedance Tester	1
2	Electrical Line Inspection and Corrective Action Test Procedure and Report	1

Test Instruments Required

- PRO*Fi*TEST 0100S-II by METRAWATT—Line Impedance Tester
- Test set in K100 Carrying Case – M509H (Optional)
- DVM Fluke 87 (True RMS) or equivalent

- GND extension cable (8m)—purchased locally
- Torque screwdriver capable of adjustment to 1.2 Nm (10.6lbs/in)

Estimated Time

Estimated time for the procedure is two hours not including corrective action.

If TEAL (**PLC—Power Line Conditioner**) is installed, fill in the entire checklist.

If TEAL (PLC) is not installed, skip Section *Measured Values on TEAL (PLC)/WDC Input* .

For systems with WDC without TEAL (PLC), fill in the entire checklist.

WARNING

ELECTRICAL HAZARD! THE MEASUREMENT IS DONE WITH POWER ON.
MAKE SURE NOT TO SHORT BETWEEN TERMINALS WHEN TAKING MEASUREMENTS.

Measurements must be done in two places:

1. On the TEAL (PLC) input power connection (if TEAL is installed). Perform Section *Measured Values on TEAL (PLC)/WDC Input* and Section *Measured Values on PDC Input* .
2. On the input power terminals in the PDC (see Section *Measured Values on PDC Input*).

If any measurements are not within the required specification, corrective action must be taken.

Test Procedure Preparation

WARNING

ELECTRICAL HAZARD! TURN OFF THE UPS IN THE SYSTEM BY PRESSING THE OFF BUTTON.

1. Turn OFF the input power to the PDC from the F99 breaker and the on-site power switch and to the TEAL (PLC).
2. If a WDC is installed on site, switch the WDC to manual (bypass) mode.

NOTE:

At the end of the measurement procedure, return the WDC to automatic mode.

3. Remove the caps of the input 3-phase terminal of the PDC (F100) and, if measuring on TEAL (PLC) input, make sure that you have access to the TEAL (PLC) input power.
4. Turn ON the input power to the PDC/TEAL (PLC).

WARNING

ELECTRICAL HAZARD! VERIFY THAT THE F99 BREAKER IS OFF (DOWN).

For measuring voltages, use the DVM Fluke 87 or equivalent according to the checklist.

5. Turn ON the PROFiTEST 0100S-II Line Impedance Tester by pressing the yellow Menu button and perform the following measurements:
   - Checking the Line Impedance L–L
   - Checking the Impedance Between Line–Neutral
   - Checking the Impedance Between L–GND
   - Checking the Impedance Between Neutral –GND
   - Checking the Resistance Between PE-Component GND

A.1 Checking the Line Impedance L–L

1. Turn the Function Selector switch to the Z Schl. position.
2. Connect the L1 probe to one of the phases and the PE (L2) measuring adaptor to the second phase.
3. Press the Start button, read the measurement on the display, and record the measurement in the checklist.
4. Repeat Steps 2 and 3 according to the checklist.

A.2 Checking the Impedance Between Line–Neutral

1. Turn the Function Selector switch to the Z Schl. position.
2. Connect the L1 probe to one of the phases and the PE (L2) measuring adaptor to the Neutral terminal.
3. Press the Start button, read the measurement on the display, and record the measurement in the checklist.
4. Repeat Steps 2 and 3 according to the checklist.

A.3 Checking the Impedance Between L–GND

1. Turn the Function Selector switch to the Z Schl. position.
2. Connect the L1 probe to one of the phases and the PE (L2) measuring adaptor to GND.
3. Press the Start button, read the measurement on the display, and record the measurement in the checklist.
4. Repeat Steps 2 and 3 according to the checklist.

A.4 Checking the Impedance Between Neutral –GND

1. Turn the Function Selector switch to the RE position.
2. Connect the L3 (N) probe to the ground jack on the side of the PROFiTEST 0100S-II Line Impedance Tester.
3. Connect the L1 probe to one of the phases and the PE (L2) measuring adaptor to the PE terminal.
4. Connect the L3 (N) probe to the Neutral terminal.
5. Press the Start button, read the measurement on the display, and record the measurement in the checklist.

A.5 Checking the Resistance Between PE-Component GND

1. Turn the Function Selector switch to the RE position.
2. Connect the L3 (N) probe to the ground jack on the side of the PROFiTEST 0100S-II Line Impedance Tester.
3. Connect the L1 probe to one of the phases and the PE (L2) measuring adaptor to the PE terminal.
4. Connect the L3 (N) probe to each one of the component GND (use the extension GND cable).
5. Press the Start button, read the measurement on the display, and record the measurement in the checklist.
6. Repeat Steps 4 and 5 for each GND component.

NOTE:

At the end of the measurement procedure, return the WDC to automatic mode.

Electrical Line Inspection and Corrective Action Test Report

Fill in the relevant information prior to performing the procedure:

Date:	System Serial No.:	
Hospital Name:	Country:	
FSE Name:	Tel.:	
Main Power Line	☐ 480V	☐ 420V
	☐ 460V	☐ 400V
	☐ 440V	☐ 380V
Line Frequency	☐ 50Hz	☐ 60Hz

Measurement Checklist and Corrective Actions

Nominal Line Parameters

	REQUIRED DEVICE DATA ACCORDING PG	EXISTING DEVICE DATA
Fuse type and rating (on site installation)	Min.:100 A NH gl/gG Selectivity 1:1.25 or Min.:125 A NH gl/gG selectivity 1:1.6	
Type of net: delta, Y, grounding point on secondary side of house transformer	Y with center grounding	
Frequency	50 or 60 Hz	
Output Power Line Voltage	380 400 420 440 460 480	
GFCI type and rating (Ground Fault Control Indicator)	125A 30mA for alternating and DC current	

Over-voltage and lightning protection, type and rating	Lightning protection at station transformer And Surge protection down to 2 kV level in CT power connection panel.	
UPS installed (Type and tech.data)	No nominal equipment	
Line conditioner (Type and tech.data)	No nominal equipment	
No other load connected to the CT power line	No other load allowed	
Emergency power supply installed	No nominal equipment	

Check that the GND and N (if present) are isolated from the Power Distribution Panel. If they are not, isolate them.

Measured Values on TEAL (PLC)/WDC Input

	NOMINAL VALUE	**MEASURED VALUE**
LINE FREQUENCY	50 or 60 Hz +/-5%	

Measurement equipment used type, manufacturer, serial number and calibration date.	
LINE VOLTAGE	
Measurement equipment used type, manufacturer, serial number and calibration date.	

Voltage L to L	380 V +/-10% 400 V +/-10% 420 V +/-10% 440 V +/-10% 460 V +/-10% 480 V +/-10%	

L1-L2	List measured values in the column on the right	
L1-L3		
L2-L3		
L to GND	220 V+/-10% 230 V+/-10% 243 V+/-10% 254 V+/-10% 265 V+/-10% 277 V+/-10%	
L1- GND	List measured values in the column on the right	
L2- GND		
L3- GND		

LINE IMPEDANCE	
Measurement equipment used type, manufacturer, serial number and calibration date.	

L to L	380V:max 0.150 Ω 400V:max 0.165 Ω 420V:max 0.180 Ω 440V:max 0.200 Ω 460V:max 0.220 Ω 480V:max 0.240 Ω	
L to GND	max 0.150 Ω	
L1-L2	List measured values in the column on the right	
L1-L3		
L2-L3L2-L3 Perform measurement according to *Section A.1*.		
L to GND	Smaller than measured values L to L	

L1- GND	List measured values in the column on the right	
L2- GND		
L3- GND Perform measurement according to *Section A.3*.		

Corrective Action

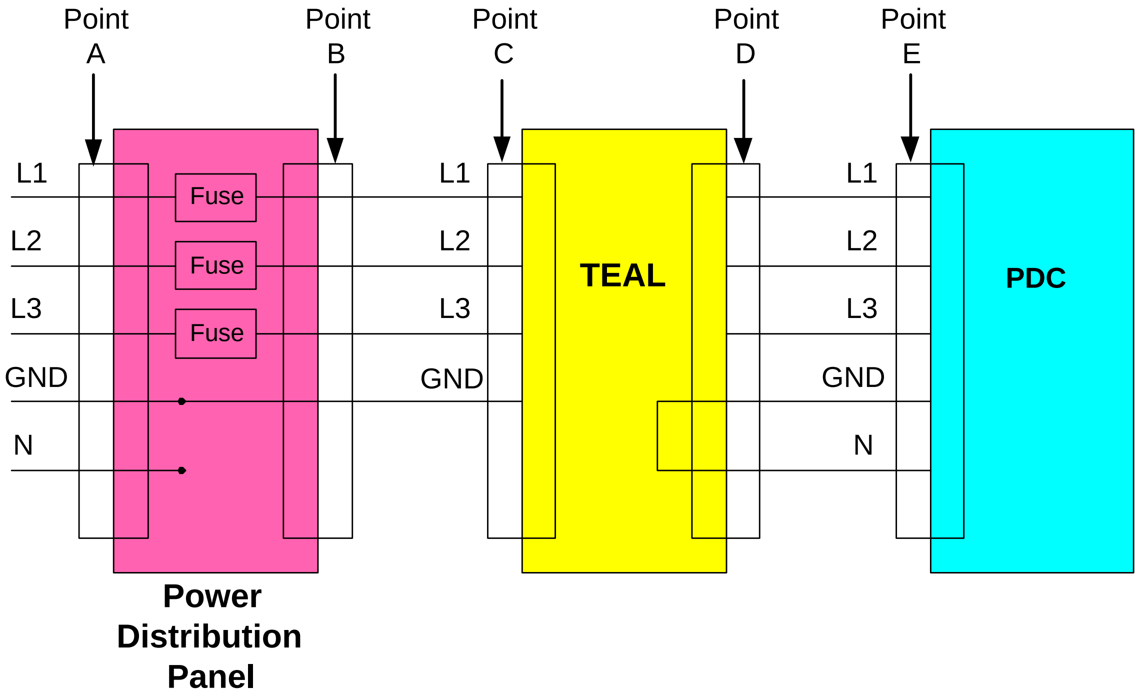

Point A
Point B
Point C
Point D
Point E
L1
L2
L3
GND
N
Fuse
Fuse
Fuse
L1
L2
L3
GND
TEAL
L1
L2
L3
GND
N
PDC
Power Distribution Panel

Figure A-1: Connection Block Diagram (with TEAL)

If any of the measurements taken in Section *Measured Values on TEAL (PLC)/WDC Input* are not within tolerance:

1. Check for loose connections on the TEAL (PLC) input terminal (Point C).
2. Contact the site electrician and perform the measurements in Section *Measured Values on TEAL (PLC)/WDC Input* at Point B.
3. If the measurements are within the tolerances, check the cables between Points B and C. For example, the cable length may be too long, or the cable diameter is too small (not thinner than 25mm^2—AWG3).

4. If the measurements are not within the tolerances, contact the site electrician and check for loose connections on the Power Distribution Panel output terminal (Point B).
5. Contact the site electrician and perform the measurements in Section *Measured Values on TEAL (PLC)/WDC Input* at Point A.
6. If the measurements are within the tolerances, contact the site electrician and check the fuses and connections inside the Power Distribution Panel.
7. If the measurements are not within the tolerances, contact the site electrician and check the input lines from site power source:
   - Check for loose connections at power source.
   - Check that there is no voltage difference >1VAC between GND and N and that they are connected together.
   - Check that the GND cable diameter is 25mm^{2}·or higher.

Measured Values on PDC Input

	NOMINAL VALUE	MEASURED VALUE
LINE FREQUENCY	50 or 60 Hz +/-5%	

Measurement equipment used type, manufacturer, serial number and calibration date.	
LINE VOLTAGE	
Measurement equipment used type, manufacturer, serial number and calibration date.	

Voltage L to L	380 V +/-10% 400 V +/-10% 420 V +/-10% 440 V +/-10% 460 V +/-10% 480 V +/-10%	

L1-L2	List measured values in the column on the right	
L1-L3		
L2-L3		
L to N	220 V+/-10% 230 V+/-10% 243 V+/-10% 254 V+/-10% 265 V+/-10% 277 V+/-10%	
L1-N	List measured values in the column on the right	
L2-N		
L3-N		
PE-N	<1V	

LINE IMPEDANCE	

Measurement equipment used type, manufacturer, serial number and calibration date.	

L to L	380V: max 0.150 Ω 400V: max 0.165 Ω 420V: max 0.180 Ω 440V: max 0.200 Ω 460V: max 0.220 Ω 480V: max 0.240 Ω	
L to N	max 0.150 Ω	
N to GND	max 0.150 Ω	
L1-L2	List measured values in the column on the right	
L1-L3		
L2-L3 Perform measurement according to *Section A.1*.		

L1-N	List measured values in the column on the right	
L2-N		
L3-N Perform measurement according to *Section A.2*.		

IMPEDANCE FROM GROUND CONNECTION PE OF THE SYSTEM INPUT TO THE NEAREST CONNECTION OF N.	
Measurement equipment used type, manufacturer, serial number and calibration date.	

Impedance from ground connection PE of the PDC cabinet to the nearest connection of N. Perform measurement according to *Section A.4*.	Value smaller 0.150 Ω	

GROUND IMPEDANCE OF THE SYSTEM INSTALLATION		

Measurement equipment used type, manufacturer, serial number and calibration date.	

PDC protective conductor terminal to every conductive surface on a system component	Value smaller 0.100 Ω	
1. Gantry	List measured values in the column on the right	2.
3. Table		4.
5. WCS		6.
7. Local GND in Distribution Panel Perform measurement according to *Section A.5*.		8.

Corrective Action

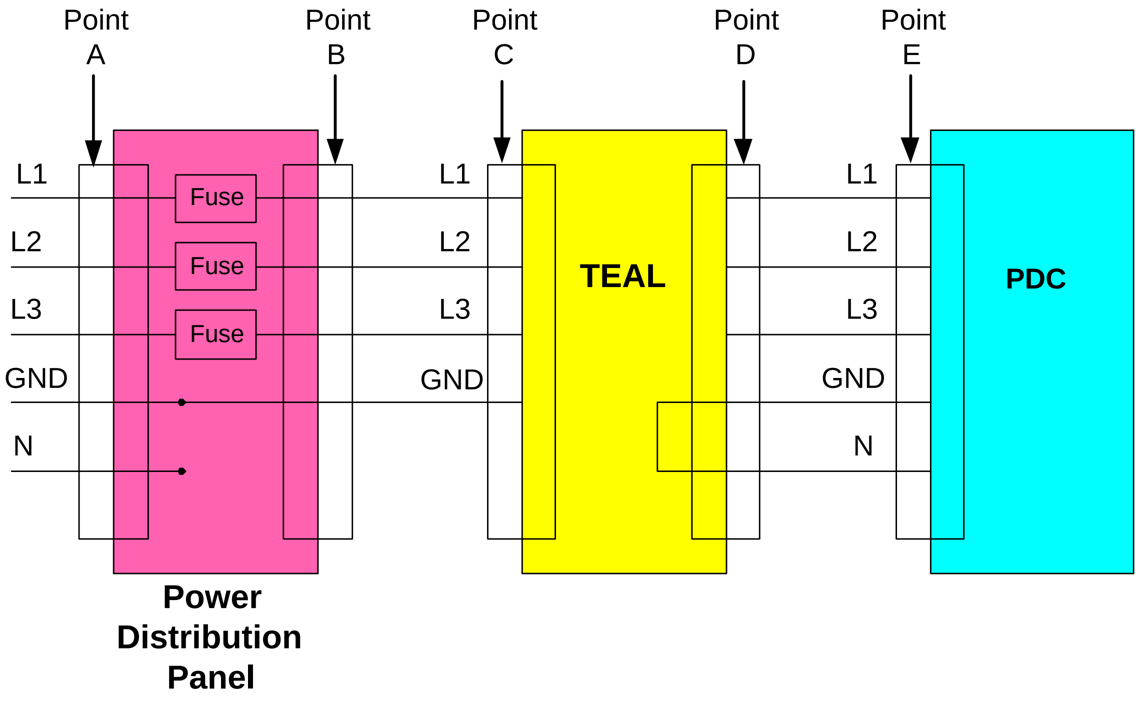

Point A
Point B
Point C
Point D
Point E
L1
L2
L3
GND
N
Fuse
Fuse
Fuse
L1
L2
L3
GND
TEAL
L1
L2
L3
GND
N
PDC
Power Distribution Panel

Figure A-2: Connection Block Diagram (with TEAL)

For Systems With TEAL (PLC)

If any of the measurements taken in Section *Measured Values on PDC Input* are not within tolerance:

1. Check for loose connections on the PDC input terminal (Point E).
2. Perform the measurements in Section *Measured Values on PDC Input* at Point D.
3. If the measurements are within the tolerances, check the cables between Points D and E. For example, the cable length may be too long, or the cable diameter is too small (not thinner than 25mm^2—AWG3).

4. If the measurements are not within the tolerances, check for loose connections on the TEAL (PLC) output terminal (Point D).
   Check the connection between GND and N inside the TEAL (PLC).

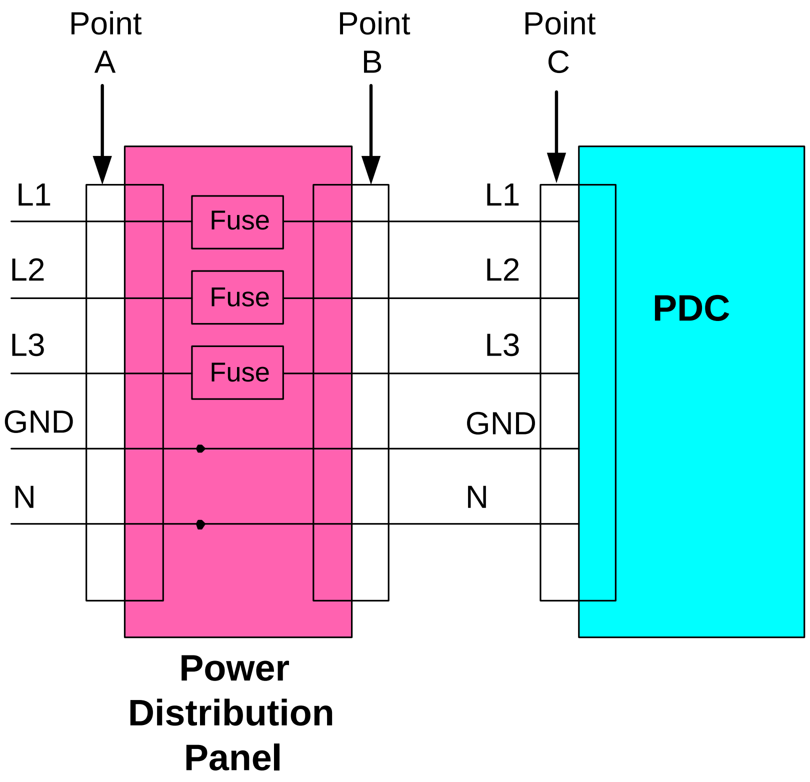

Point A
Point B
Point C
L1
L2
L3
GND
N
Fuse
Fuse
Fuse
L1
L2
L3
GND
N
PDC
Power Distribution Panel

Figure A-3: Connection Block Diagram (without TEAL)

For Systems Without TEAL (PLC)

If any of the measurements taken in Section *Measured Values on PDC Input* are not within tolerance:

1. Check for loose connections on the PDC input terminal (Point C).

2. Perform the measurements in Section *Measured Values on PDC Input* at Point B.
3. If the measurements are within the tolerances, check the cables between Points B and C. For example, the cable length may be too long, or the cable diameter is too small (not thinner than 25mm^2—AWG3).
4. If the measurements are not within the tolerances, contact the site electrician and check for loose connections on the Power Distribution Panel output terminal (Point B).
5. Contact the site electrician and perform the measurements in Section *Measured Values on PDC Input* at Point A.
6. If the measurements are within the tolerances, contact the site electrician and check the fuses and connections inside the Power Distribution Panel.
7. If the measurements are not within the tolerances, contact the site electrician and check the input lines from site power source:
   - Check for loose connections at power source.
   - Check that there is no voltage difference >1VAC between GND and N and that they are connected together.
   - Check the GND cable diameter is 35mm$^{2.}$